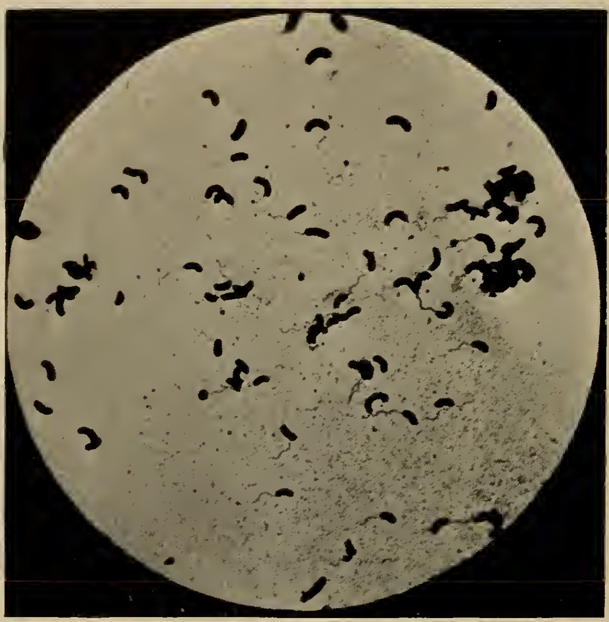


Spirilla choleræ Asiaticæ, showing flagella. × 1000. (Photo-micrograph by Professor JOHN GUITÉRAS, M.D.)

Encysted trichina spiralis, in the injected tongue of a cat. × about 150. (Photo-micrograph by Dr. J. P. TUNIS, from a specimen prepared by the author. *Trans. Path. Soc. of Phila.*, vol. xv., page 282.)

NOTES

ON THE

DEMONSTRATIONS IN MORBID ANATOMY

(INCLUDING AUTOPSIES),

DELIVERED IN THE MEDICAL DEPARTMENT OF THE
UNIVERSITY OF PENNSYLVANIA BEFORE
THE THIRD-YEAR CLASS.

BY

HENRY W. CATTELL, A.M. M.D.,

DEMONSTRATOR OF MORBID ANATOMY IN THE UNIVERSITY OF PENNSYLVANIA; FELLOW OF THE
COLLEGE OF PHYSICIANS; PROSECTOR TO THE AMERICAN ANTHROPOMETRIC SOCIETY;
PATHOLOGIST TO PRESBYTERIAN HOSPITAL, THE INSTITUTION FOR
FEEBLE-MINDED CHILDREN AT ELWYN, ETC.

ILLUSTRATED.

PHILADELPHIA:
INTERNATIONAL MEDICAL MAGAZINE CO.
716 FILBERT STREET.
1894.

DORNAN, PRINTER.

PREFACE.

The following pages are printed in order that the work of the Third-Year Class may be rendered slightly easier. They are far from forming a complete course in Morbid Anatomy. Much material contained in the able didactic lectures of the Professor of Pathology, Dr. John Guitéras, is necessarily gone over in the demonstrations, but is either omitted in the notes or else stated in the briefest possible manner.

My thanks are due to many of my former students for the valuable aid which they have given me in the preparation of the notes. I am especially indebted to Dr. G. K. Edwards, Dr. J. P. Tunis, Mr. Frank Scheaffer, Miss McCaffery and Miss Sinclair for most of the illustrations (which were made under the supervision of the author); to Mr. J. W. Brandon for his notes on the demonstrations taken during the session of 1892–'93; and to Drs. J. A. Scott, F. E. Murphy, and A. W. Peckham, and Messrs. A. A. Poehner and N. V. Shannon for their practical suggestions.

"Practical Pathology," by Woodhead, third edition; Osler's "Practice of Medicine," or Pepper's "American Text-Book of the Theory and Practice of Medicine;" "Principles and Practice of Surgery," by Ashhurst; "or "American Text-Book of Surgery," by Keen and White, contain, practically, all the pathological information necessary. The seventh German edition of Ziegler's "Pathology," the new English translation of which is not completed, is by far the best single work on the subject.

Frequent references are made to Gowers' "Diseases of the Nervous System;" Keating's "Cyclopædia of the Diseases of Children;" Orth's "Pathologisch-anatomische Diagnostik;"

Gray's "Anatomy;" Piersol's "Text-Book of Histology;" Sutton's "Tumors: Innocent and Malignant;" Peyer's "Atlas der Mikroskopie am Krankenbette;" v. Jaksch's "Klinische Diagnostik;" Klein's "Histology;" "Clinical Manual," by Finlayson; Pepper's "System of Medicine;" Foster's "Encyclopædic Medical Dictionary;" Sajous's "Annual of the Universal Medical Sciences;" Ball's "Essentials of Bacteriology; Virchow's "Archives;" Eisenberg's "Bakteriologische Diagnostik;" Quain's "Dictionary of Medicine;" Reese's "Medical Jurisprudence;" Hamilton's "Text-Book of Pathology;" "Transactions of the Philadelphia Pathological Society;" Ewald's "Diseases of the Stomach," and many magazine articles in current medical literature.

Classifications and definitions used by Professor Guitéras in his lectures are marked with a *.

3455 WOODLAND AVENUE, April, 1894.

CONTENTS.

PART I.

PART II.

PART III.

PART I.

GENERAL PATHOLOGY.

Pathology has been defined as having everything to do with disease except its treatment. It represents the scientific side of medicine, and should, therefore, be studied in connection with all the various branches of medicine. In France they call medicine internal pathology, and surgery external pathology.

For convenience of study, pathology is divided into :

1. **Etiology**: the study of the causation of disease. The greatest advancement in medicine of late years has been due to the discoveries made in bacteriology. Lister put into practical use these discoveries when he placed antiseptic surgery on a firm basis.

2. **Morbid Anatomy**: the study of the changes of structure in disease; whether these changes be macroscopic or microscopic. By macroscopic is understood that the morbid changes in the tissue or organ are readily seen with the naked eye—often used synonymously with gross, as in gross morbid anatomy. By microscopic is understood that the morbid changes are made visible by means of amplification of the object by the use of a magnifying glass or lens.

3. **Morbid Physiology**: the study of the changes of function in disease. These changes involve such complex chemical reactions that they are but little understood.

For convenience of study, pathology is divided into **General** and **Special Pathology**. Morbid processes, whether elementary or compound, occurring in different organs or tissues, are treated under General Pathology; while those processes occurring in particular organs or tissues are spoken of as belonging to Special Pathology.

At the beginning of your pathological studies learn to imagine that each specimen seen has formed an integral portion of a living human being. When you see an aneurism of the arch of the aorta, think of the person in whom it was found and the changed anatom-

ical relations and the altered functions which produced it, and were produced by it; and, conversely, when you are examining a person afflicted with disease, try to imagine to yourself the pathological changes which are going on in the living body. In this manner you will best be able to fit yourselves to perform your duties as future members of the medical profession.

In General Pathology it is useful to study first the **elementary pathological processes**, which may be either **progressive** (integrating), or **retrograde** (disintegrating); then the **composite pathological processes**; and, lastly, the **specific diseases**.

Hypertrophy.

Physiological example: Growth of a child.

A.

1. Simple. Ex., uterus; heart.
2. Numerical. Ex., supernumerary organs, as of the spleen.

B.

1. True. *a.* Compensative. Ex., left ventricular hypertrophy, in general arterio-capillary fibrosis. *b.* Congenital. Ex., acromegaly, polydactylism.
2. False or pseudo. Ex., hypertrophic cirrhosis of the liver; pseudo-hypertrophic muscular paralysis.

Fresh specimens (not necessarily pertaining to the above subject).

Exhibits.

1. Fœtus in utero.
2. Slides showing normal and hypertrophied muscle fibres from the uterus.
3. Supernumerary spleens.
4. Arteries from a case of collateral circulation.
5. Heart showing left-sided hypertrophy.
6. Pictures from a case of acromegaly.
7. Specimens of polydactylism.

8. Slide showing hypertrophic cirrhosis of the liver.

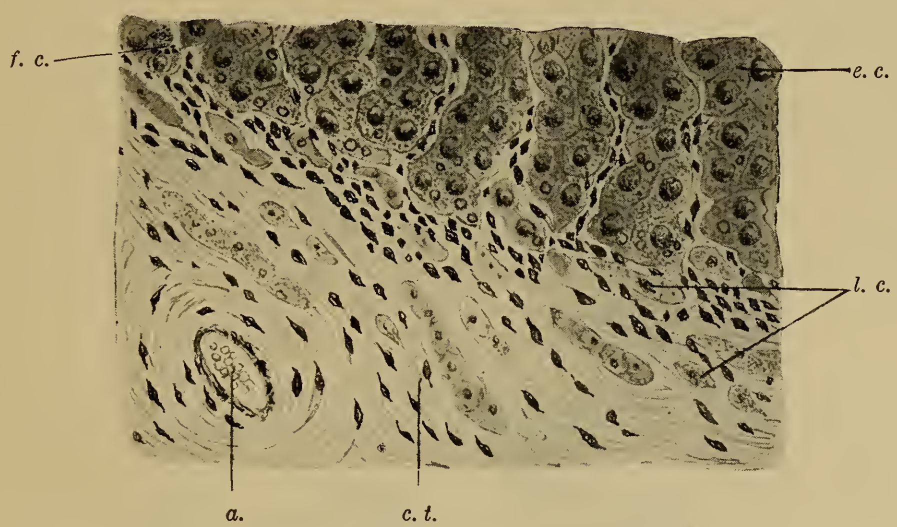
9. Picture of a child raising itself from the ground in pseudo-hypertrophic muscular paralysis.

10. Slide of muscle from a case of pseudo-hypertrophic muscular paralysis.

Like a great many other words in medicine, **hypertrophy** is used in both a general and in a special way. In a general way it refers to the enlargement of an organ, no matter to what cause it may be due; while true hypertrophy consists in an enlargement of an organ due to the fact that the relation of the pre-existing cells is not materially changed, and that the increase is due either to an increase in size (**simple hypertrophy**) or number (**numerical hypertrophy**) of the cells.

In this enlargement of an organ there is nothing new added from without, and the constituent parts of an organ are better nourished and more work is demanded of and accomplished by such an organ.

FIG. 1.

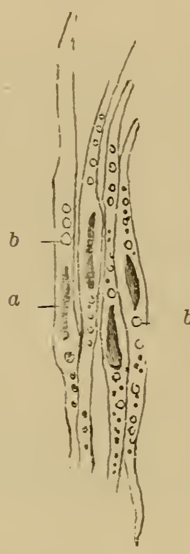


Hypertrophic cirrhosis of the liver. Notice that the connective tissue, which is the unimportant portion of the liver, is largely increased above the normal. × 300. (WOODHEAD.) *e. c.* Columns of liver cells at the margin of a group of lobules. Between these columns young connective tissue is seen. *f. c.* Liver cell infiltrated with fat. *l. c.* Atrophied and flattened liver cells shaved off from the main body by the encroaching connective tissue, *c. t.* *a.* Small branch of the hepatic artery.

In the use of pseudo-hypertrophy there is a contradiction of terms, for how can a thing be true and false at the same time? The constituent of the tissue that is here increased in amount is usually the unimportant one, namely, the connective tissue, as in hypertrophic cirrhosis of the liver. (See Fig. 1.)

In simple hypertrophy there is an enlargement of the pre-existing cells. In the uterus during pregnancy the cells may be increased fifteen to twenty times above what they are when in a state of inactivity. (See Fig. 2.) In the heart and elsewhere this increase in size of the cells is more difficult to demonstrate.

FIG. 2.



Muscular fibre-cells from the uterus three weeks after delivery, treated with acetic acid. The enlarged fibres are now undergoing atrophy by means of fatty degeneration. × 350. (KÖLLIKER. From Quain's *Anatomy*.)
a, nucleus; *b*, fat-granules.

In numerical hypertrophy there is an increase in the number of cells existing in the part. This is often called hyperplasia; while others employ this word in a more general sense, using it as a synonym of a neoplasm or new growth.

It is easily seen that both physiologically and pathologically hypertrophy will consist in both an increase in the number and the size of the cells of an organ, as is seen in the enlargement of the previously formed vessels in the establishment of a collateral circulation. In true hypertrophy, where more work is gotten out of an organ, we may have it due to the fact that it is compensative. This is illustrated by the overgrowth of a kidney which has had to do not only its own share of work, but also that of the opposite

FIG. 3.

Transverse section through the ventricles of the heart in a case of insufficiency and stenosis of the aortic valves. The left ventricle (on the right of the illustration) is hypertrophied to at least twice its normal thickness. Half natural size. (After ZIEGLER.)

kidney, which may have been excised or damaged by disease. Another example is the hypertrophy of the left ventricle of the

heart, which occurs in those persons affected with arterio-capillary fibrosis or aortic stenosis. (See Fig. 3.)

Hypertrophy may occur congenitally. This is well seen in acromegaly, a disease which has attracted considerable attention of late. This consists of an overgrowth of the extremities, often associated with an enlargement of the facial bones and deformity of the vertebræ. It occurs in young and middle-aged people, rarely in those who are advanced in years. The increase is in the breadth of the bone, and not in the length, and shows numerous exostoses on their ends. The cause is not known.[1] For a picture of this condition see Marie's picture in Osler's account of this disease in Pepper's *Text-book of Medicine.*

In a case of polydactylism, also an illustration of congenital hypertrophy, which occurred in a female body in the dissecting-room of the University in 1886, there was an extra finger to each hand, and an extra toe to each foot. (See Fig. 4.)

FIG. 4.

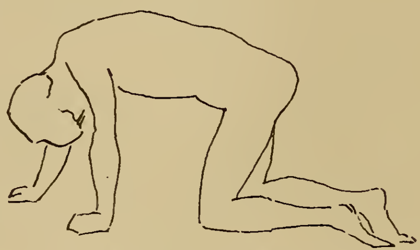
Case of polydactylism.

Pseudo-hypertrophic muscular paralysis[2] is due to a defective tendency of development of the germinal tissue which forms muscle. It is therefore congenital, while rarely hereditary; and if so, is inherited through the mother, as in the case of hæmatophilia. Several members of the same family may be affected, as in the case of three brothers at Elwyn, studied by Drs. Kerlin, Mills, and Wilmarth. Males are four to seven times more frequently affected, and in females the disease is milder, of later manifestation, less likely to cause death, and no doubt more frequently overlooked. It is a disease of early life, though rarely it may not have been noticed until after puberty, though in all probability it has been progressing for several years and has been

[1] Ziegler: Seventh edition, p. 179.
[2] See Gowers; second edition, p. 503, et seq.

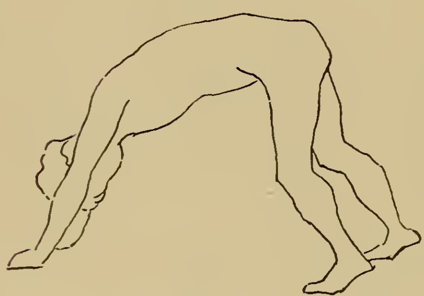
overlooked. The muscles of the calf are most frequently affected, the infra-spinatus next. The intrinsic muscles of the hand usually escape, and thus aid us in diagnosing the disease from spinal muscular atrophy, where they are usually primarily affected. The latissimus dorsi may be congenitally absent. The calf of a boy aged eight may measure in circumference as much as it should at fourteen. The mode of rising from the ground is quite characteristic, the child using the lower limbs as a ladder upon which he climbs, in order to gain the erect position. (See Figs. 5, 6, and 7.) Later

FIG. 5.



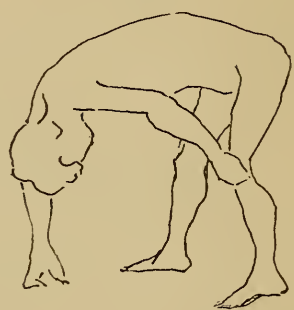
Method of getting up from the ground in a case of pseudo-hypertrophic muscular paralysis. First position.

FIG. 6.



Second position.

FIG. 7.

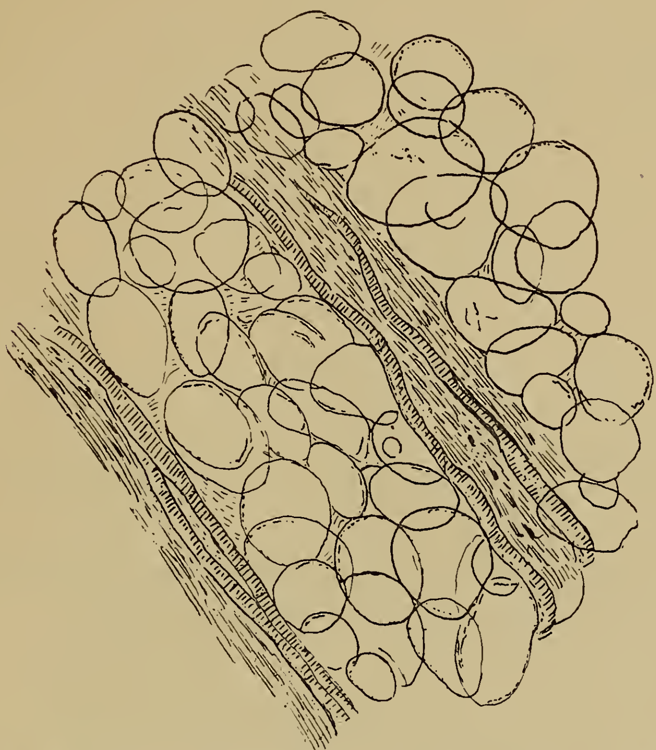


Third position: The characteristic one where the child climbs up its own limbs, using them as a ladder. (After GOWERS.)

on the joints become distorted, and curvature of the spine often occurs. The reaction of degeneration is never present, though there may be a diminution both to the faradic and galvanic currents. The knee-jerk may be normal, and finally become lost. The muscles are pale and yellowish in color, the resemblance to fat being often well marked. Under the microscope the degenerated, narrowed, and irregular shapes of the voluntary muscles are found pressed together by connective tissue and a large amount of fat. (See Fig. 8.) There is no primary lesion of the brain, cord, or motor nerves, as was formerly believed, the degenerative changes in the anterior horns being no more than could be accounted for by the disuse of the muscles. During life the pathologist is some-

times called upon to remove some of the muscles for examination. This is done by "harpooning" some of the muscles of the calf

FIG. 8.



Slide showing muscle from a case of pseudo-hypertrophic muscular paralysis. The atrophied muscle, the fat, and the connective tissue are well shown. (GOWERS.)

and examining by the microscope, care being taken that the subcutaneous fat be not mistaken for muscle that has undergone fatty degeneration.

Atrophy.

Phys. ex.: Thymus gland.

A.

1. Simple.
2. Numerical.
3. Combination of 1 and 2 most usual form. Ex., chronic spinal muscular atrophy.

B.

1. Active.
2. Passive.

C.

1. Senile. Ex., organs of generation at the menopause.
2. Inactive. Ex., muscles of arm after a fracture.

3. Tropho-neurotic. Ex., myelitis.
4. Pigmentary. Ex., brown atrophy of the heart.
5. Pressure. Ex., aneurism of arch of the aorta, eroding bone.
6. Starvation.

Fresh specimens.

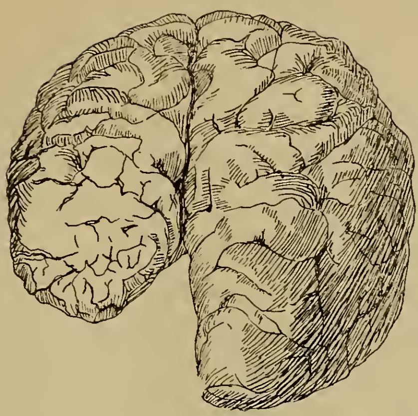
Exhibits.

1. Engraving showing normal position of the thymus gland.
2. Atrophied spleen, showing marked pigmentation. Weight, 186½ grains.
3. Picture of a case of chronic spinal muscular atrophy.
4. Slide from a case of spinal muscular atrophy.
5. Brain, showing atrophy.
6. Uterus and appendages of a senile woman.
7. Slide, showing brown atrophy of heart.
8. Aneurism, eroding bone.

Atrophy is a diminution in the size of an organ or part, due to a primary decrease in the size (simple atrophy); and a secondary decrease in the number (numerical atrophy) of the cells forming such an organ or part. Smallness of an organ does not therefore actually constitute atrophy, unless the cells which previously existed have been diminished in size or number. If there is a loss of a cell, no matter how small it may be, without a corresponding gain in another part of the organ, there will be a loss of function, and therefore true atrophy.

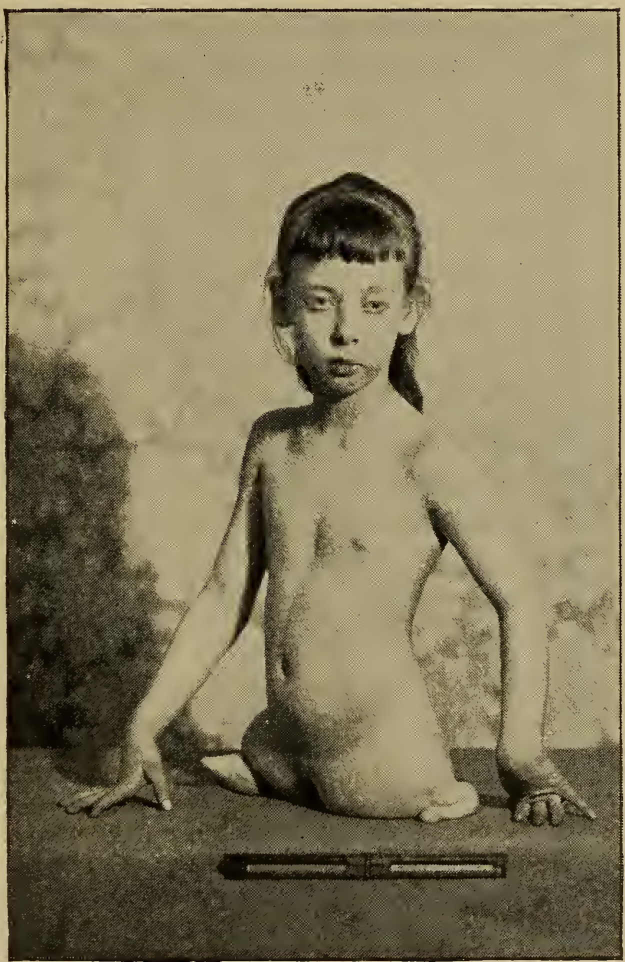
Hypoplasia is a failure of a body, system, organ, or part to develop to the standard consistent with the normal, as is sometimes seen in the sexual organs and large bloodvessels of those affected with chlorosis. The brain may show this condition. (See Fig. 9.) By aplasia or agennesia is understood that a part or portion of a part has never existed, as in apodia, where the lower limbs are congenitally absent and the rest of the body is well formed. (See Fig. 10.)

FIG. 9.



Hypoplasia of the left occipital region in a deaf and dumb person. One-third of the natural size. (After ZIEGLER.)

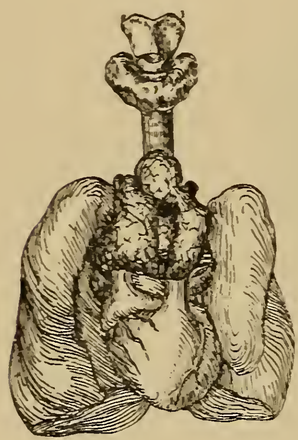
FIG. 10.



G. E. Shoemaker's case of apodia in a girl aged nine. Sitting position. (*Trans. of the College of Phys.*, vol. xiv.)

The thymus gland (see Fig. 11) is an excellent example of physiological atrophy. This gland reaches its full growth at the second year of life, and then diminishes in size until at puberty it has almost disappeared. It lies about an inch below the thyroid gland, between the apices of the lungs, in front of the trachea and the large bloodvessels of the heart, and resting upon the pericardium. It is about two inches long and one and a half inches in breadth. Mistakes are frequently made at post-mortems on children in regard to the location of this gland as well as to its nature when found.

Fig. 11.

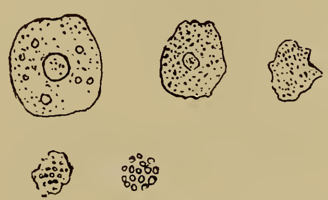


Normal position of the thymus gland in a child aged about two years. One-third natural size. (After Heitzmann.)

A good example of a combination of simple and numerical atrophy is to be seen in that interesting disease known as chronic spinal muscular atrophy: the walking skeletons of the dime museums. The atrophy of the muscles is due to degenerative changes which take place in the large ganglion cells of the anterior horns of the spinal cord, associated with a corresponding degeneration of the motor nerves which arise in this situation. The lateral and pyramidal tracts are usually also affected in the late stages of the disease. It occurs three times more frequently in males than in females. Nine times out of ten the atrophy starts in the arms, either in the muscles of the shoulder or of the hands. Death is frequently caused by interference with the muscles of respiration. At a post-mortem made at Elwyn on a girl aged seventeen, the diaphragm could be plainly seen through, the tendonous portions being much larger than normal, and the whole looking like the diaphragm of an infant. The sterno-mastoid muscles were unusually prominent, on account of the great emaciation, though they were no larger than normal in a healthy girl seventeen years old. The reaction of degeneration may be present. The muscles are pale in color, and may be found with difficulty. The muscle fibres may show vitreous and fatty degeneration, narrowing, and a peculiar longitudinal striation. The large ganglion cells of the anterior horns may be entirely gone or show numerical and simple atrophy; those remaining may have lost their prolongations.

By active atrophy is meant that the cells are not able to use up all or any of the nourishment which is normally offered to them. By passive atrophy, that there is a qualitative or quantitative change of the nourishing material, or that there is supplied to the cells a substance which is injurious to their proper nutrition. For example, if one thousand cells have been receiving enough blood to nourish them and the amount of blood is diminished in quality or quantity one-half, only five hundred cells can be properly nourished. What will happen? The cells will not receive their normal amount of nourishment, and probably several hundred will disappear, and those which remain will be reduced in size, and the functional activity of the part will be lowered. (See Fig. 12.)

FIG. 12.



Atrophic liver cells from cyanotic atrophy of the liver in different stages of simple atrophy. × 400. (HAMILTON.)

In myelitis bed-sores may be produced in four to five days, while in lesions of the brain, such as a hemorrhage into the internal capsule, the patient may remain in bed for years without the production of bed-sores. This is a tropho-neurotic form of atrophy, and is due to the fact that the trophic nerves which control the nutrition of the part have been cut off from communication with the spinal cord. Charcot's joints in tabes dorsalis is another example.

Degenerations.

Infiltrations { Qualitative, Quantitative.	Metamorphoses or degenerations proper.
1. Fatty.	1. Fatty.
2. Calcareous.	2. Amyloid.
3. Pigmentary.	3. Hyaline.
4. Dropsical.	4. Parenchymatous.
5. Glycogenic.	5. Serous.
6. Urinary, lactic, etc.	6. Colloid.
	7. Mucoid.

(The degenerations can be greatly increased in number beyond the more important ones mentioned above)

By degeneration is understood structural impairment of the cells of a tissue, with loss of function. The process is therefore an elementary, morbid process, which is retrograde in its nature. Two divisions are usually made, namely, into the infiltrations and the metamorphoses or degenerations proper, though there is often no sharp distinction between them. In an infiltration something is always added to the cell from without. This material may be foreign to the part, or it may be a normal constituent of the part added either in excess (quantitative) or changed in its nature (qualitative). In a metamorphosis we have one or more of the constituents of the cell itself being converted into a new material, the change often being materially assisted by new matter brought from without, or a normal constituent of the cell is formed and stored up in abnormal quantities in the cell. The blood is the usual agent in bringing the new material, though it may gain access to the cell in other ways.

Fatty Infiltration.

Phys. ex.: Milk.

Exhibits.

Slide showing human milk.
Slide showing cow's milk.
Slide showing emulsion of cod-liver oil.
Fatty heart.
Fat necrosis.
Epiploicæ appendices.

Fresh specimens.

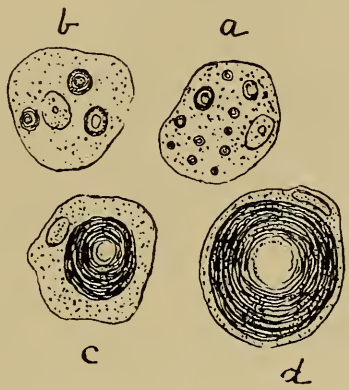
Milk is formed by a combination of fatty infiltration and fatty degeneration, the albuminates being converted into fat.

Fatty degeneration is much more serious than fatty infiltration, for in infiltration the fat has been brought from without, and there is given an opportunity for the cell to either use up this amount of fat or to have it absorbed. Therefore, even though the protoplasm

of the cell has been pushed aside, the cell may return to its normal state again; whereas, in degeneration the change has taken place in the protoplasm itself. There has been a structural change of the protoplasm of the cell, and this is a more serious matter than merely pushing it aside. The protoplasm of the cell in fatty infiltration is like an elastic ball, which will rebound when the pressure is removed.

In a normal heart you will always find some epicardial fat in the region of the septa. If fatty infiltration be excessive the entire heart may be covered with a layer of fat, and the heart itself be hid. This fat follows the trabeculæ of connective tissue into the heart muscle, and very frequently, by pressure, fatty degeneration of the muscle itself may be caused.

FIG. 13.



Fatty infiltration of liver cells. × 400. (HAMILTON.)

a, First stage, where the globules are small. *b*, Second stage, where they have partly run together. *c*, Third stage, where there is a single droplet. *d*, Fourth stage, where the nucleus of the cell has been pushed toward one side and the protoplasm of the cell has been distended.

Fat is normally to be found in many portions of the body, and, as would be expected, these situations are the ones in which an excessive deposit of fat especially occurs. In the brain, where normally there is no fat, we may, however, have a lipoma (a fatty tumor). The fat produced in fatty degeneration is frequently deposited in the neighborhood of such a degeneration, as is seen in the large amount of fat surrounding certain degenerative changes of the kidney. In starvation the fat in Tenon's capsule is the last to disappear. On account of the fact that fat is soluble in certain of the reagents—chloroform, alcohol, and ether—used in the hardening of tissues, care must be taken to first thoroughly fix the fat, as with Müller's solution, or fix and stain at once with Flemming's

solution, or better still, prepare a frozen section, cut, and stain with a one-half of one per cent. osmic-acid solution.

Under the microscope (see Fig. 13) the fat droplets are larger than in fatty degeneration, and there is a decided tendency for them to run together. In the liver it is frequently difficult or impossible to tell these conditions apart; the fat of fatty infiltration being, however, brought by the blood, those cells lying nearest to the portal blood supply are usually first affected.

Calcareous Infiltration.

Phys. ex.: Bone.

A.

From within the body. Ex., heart; osteophyte.

B.

From without the body. Ex., anthracosis.

Exhibits.

1. Calcareous infiltration of the valves of the heart.
2. Osteophyte.
3. Calcareous infiltration of a uterine fibroid; specimen and slide.
4. Concretions in gout.
5. Atheromatous bloodvessels, infiltrated with lime.
6. Calcified tubercle of lung.
7. Lipoma, undergoing calcareous infiltration.
8. Slide of encapsulated trichinæ spiralis with calcified walls.

It must be borne in mind that the use of the term calcareous infiltration is a general one, and includes other substances, such as magnesia, uric acid, coal dust, etc., and that many of these substances, such as coal and silver, may give rise at the same time to a pigmentary infiltration.

While it is, of course, distinctly understood that the material must come from without the cell, it may either come from within the body, as in the case of a fractured limb, or from without the body, as in siderosis.

You may find that the parietal pleura, becoming thickened by

inflammation, may become so infiltrated with lime that the impressions of six or seven ribs are plainly seen in the mass when it is removed.

The lime is usually found in the form of a carbonate and the magnesium in the form of a phosphate. Chemical tests will readily distinguish the one from the other. There may be an internal, or more rarely an external ossifying pachymeningitis, giving rise to osteophytes. These are most common in the falx cerebri, and sometimes give rise to pressure symptoms. They are especially found in old people and in the insane. A remark made by Gowers is as applicable here as elsewhere. It is that the pathological processes are more frequent and varied in the insane than in the sane; but this does not necessarily imply that these lesions are the cause of the person's insanity.

Calcareous infiltration is frequently of use, as is seen in the infiltration of necrotic and fibrous areas, in the tubercle, in the encysted trichinæ spiralis, in a dead fœtus, etc.

The term **anthracosis** is one to which many meanings may be attached: First, any pigmentation of the lungs with foreign material, such as coal, soot, brickdust, etc., set up by the inhalation of the above particles. Second, a disease of the lungs, in which the connective changes predominate, caused by the inhalation of coal. Third, the growth of the tubercle in such a lung as is described in two. The first is preferably called **anthracotic pigmentation**; the second, **anthracosis**; and the last, **tubercular anthracosis.** Normally, a certain amount of anthracotic pigmentation is found in the lung. In emphysema and anæmia the dark color is, by contrast, well marked. The particles usually get in, by specific gravity, to the dependent portion of the lung; they are absorbed by the lymphatic cells, carried to the glands, and often give an intense pigmentation to these glands, the student sometimes mistaking these black glands for melanotic sarcomas. The irritation produced by these particles gives rise to the formation of connective tissue. The vitality of the part is naturally lowered, and in consequence a more favorable opportunity is given for the rapid growth of the tubercle bacilli in case they should gain entrance into the lungs. The lungs of any patient who consults you should be carefully examined, if upon inspection of the hands you should discover small portions of coal imbedded in the skin. Gunpowder, salts of silver, etc., may, under certain conditions, also become imbedded in the hands without, of course, gaining entrance to the lungs.

Siderosis is an infiltration of the lungs with steel or iron; chalicosis, with marble.

Pigmentary Infiltration.

Phys. ex.: Choroid; rete Malpighii.

A.

From within the body. Ex., Addison's disease; melanotic sarcoma.

B.

From without the body. Ex., argyria. Parasitic. Ex., favus.

C.

a. Hæmatogenous. Ex., hæmociderin; hæmatoidin; bilirubin; lutein.

b. Metabolic.

Exhibits.

1. Recurrent melanotic sarcoma of the stump.
2. Crystals of hæmatoidin.
3. Slide showing hæmociderin.
4. Brown atrophy of the heart.
5. Tatoo marking of the skin.
6. Corpus luteum.

Fresh specimens.

The blood supplies or helps to elaborate the pigment formed within the body, and even the hepatogenous or metabolic varieties are therefore really derived directly from the blood. The hæmoglobin is the pigment which gives the red color to the blood.

Hæmoglobin supplies two forms of pigment, differing in their chemical composition and morphology, namely, granular, or, more usually, crystalline hæmatoidin (see Plate II.), which does not contain iron, is soluble in chloroform and ether, insoluble in alcohol, and is formed inside of large extravasations of blood, where the living cells of the body have not come in contact with the hæmo-

PLATE II.

A. Hæmatoidin crystals from old hemorrhage into brain. × 400. (After HAMILTON.)

B. Hæmociderin granules in atrophic liver cells. × 400. (After HAMILTON.)

C. Cells from a melanotic sarcoma infiltrated with melanin. × 400. (After HAMILTON.)

D. Extraneous pigmentation. Particles of coal and soot from a coal-miner's lung, along with some pigmented catarrhal cells. × 400. (After HAMILTON.)

E. Teichmann's hæmatin crystals. × about 400. (After PEYER.)

To face page 24.]

globin, and **hæmociderin** (see Plate II.), which is represented by different substances, contains Fe, is usually granular, and is formed in the midst of living cells or in their neighborhood. According to Schmidt, the hæmociderin is a transition stage, and is found in the periphery, while the hæmatoidin is the final product, and is found in the inside of the bloody mass.

In Addison's disease, which can be produced artificially by the removal of the adrenals (supra-renals), you have bronzing of the skin, due to the deposit of pigment in the epithelial cells and in the tissue.

In argyria there is a discoloration of the skin induced by the excessive use of the salts of silver (argentum). This discoloration is similar to the appearance given to the skin by the burning in the dark of common salt in alcohol.

Lutein is found in the corpus luteum and in the yelk of the egg.

In melanotic sarcoma the pigment **melanin** is to be found.

In brown atrophy of the heart the cells are atrophied or destroyed, and the hæmoglobin, as a granular material, is deposited near the poles of the corpuscle of Schultze.

Certain medicines are changed in the intestinal canal with the production of certain colors; for example, white subnitrate of bismuth, when acted upon by the sulphuretted hydrogen of the intestinal tract, is converted into black sulphide of bismuth. When using the drug in children always tell the mother or nurse that the stools will become black in color, or otherwise she may be greatly alarmed by the sudden change in the character of the stools.

Bilirubin is the chief coloring matter of the bile, and is similar in its chemical composition to hæmatoidin.

Dropsical or Serous Infiltration.

A. General. *B*. Local.

Causes: 1. Metabolic.
2. Changes in bloodvessel walls.
3. Changes in the composition of the blood.

* If the fluid contains over 3 per cent. of albumin, or if its specific gravity is above 1016, it is of inflammatory origin.

Exhibits.

1. Pericardial fluid.
2. Picture of a patient suffering from anasarca.

3. Picture of the cellular tissue of the eyes in a case of arsenical poisoning.

Fresh specimens.

Terms: 1. Œdema (hydrops): a dropsical effusion in the cellular tissue of an organ, or a part of an organ.

2. Anasarca (hyposarca): general involvement, as of both lower extremities.

3. Hydro-pericardium: dropsy in the pericardium.

4. Vacuum œdema (œdema ex vacuo): the accumulation of fluid here occurs especially in the cranial cavity and the spinal canal, when a portion of the brain or cord is destroyed and is not replaced by any other tissue.

5. Ascites: accumulation of fluid in the abdominal cavity. Ascites is due in nine cases out of ten to liver disease. Collateral circulation may take place through the œsophageal veins, and these may become much distended.

The fluid in œdema is always poorer in albumin than the plasma of the blood.

Dropsy is an accumulation of serous fluid in the subcutaneous cellular tissue, or in a serous cavity (Quain). The condition is called—

Hydrocephalus, when the fluid is in the arachnoid (external H.), or in the ventricles (internal H.);
Hydrocele, in the tunica vaginalis;
Hydrops oculi, in the eye;
Hydrops articuli, in a joint;
Hydrothorax, in the pleura.

According to Reuss, the amount of albumin in—

Pleural transudate is 2.25 per cent.;
Pericardial fluid, 1.83 per cent.;
Peritoneal transudate, 1.11 per cent.;
Subcutaneous connective tissue, 0.58 per cent.

A cut in the dependent portion of the tissue will give a clear liquid. Pitting is produced by pressure on the part, the liquid which has been expelled not immediately returning.

Œdema may be—

Toxic, thermic, traumatic, ischæmic, cachectic, etc.

As long as absorption goes on by the veins and the lymphatics usually no excess of fluid will accumulate, but if the outward flow is impeded there will be a damming back of the fluid, and the fluid will be kept within the tissue.

Chief Causes: Heart, liver, or kidney disease, the worst cases being those in which all three of these important organs are affected.

Serous infiltration is apt to be first observed in the cellular tissue about the eyes, in the feet, or at the junction of the finger and the nail in the hand. Putting on the shoes in the morning with ease and removing them at night with difficulty will frequently first attract the attention of the patient to his condition. * After a rapid walk, especially if it be cool, the finger-tips will often reveal the presence of serous infiltration.

Glycogenic Infiltration.

Glycogen may be deposited in the hepatic and renal cells in diabetes. A brown color is given with iodine.

A number of the normal fluids of the body, such as urine, saliva, milk, etc., may, by means of injury and other diseased conditions, become infiltrated into the surrounding tissues, and thereby set up peculiar degenerative changes.

Fatty Degeneration.

Phys. ex.: Uterus after childbirth.

Cause: Diminished supply of oxygen.
Ex.: Heart, liver.

Exhibits.

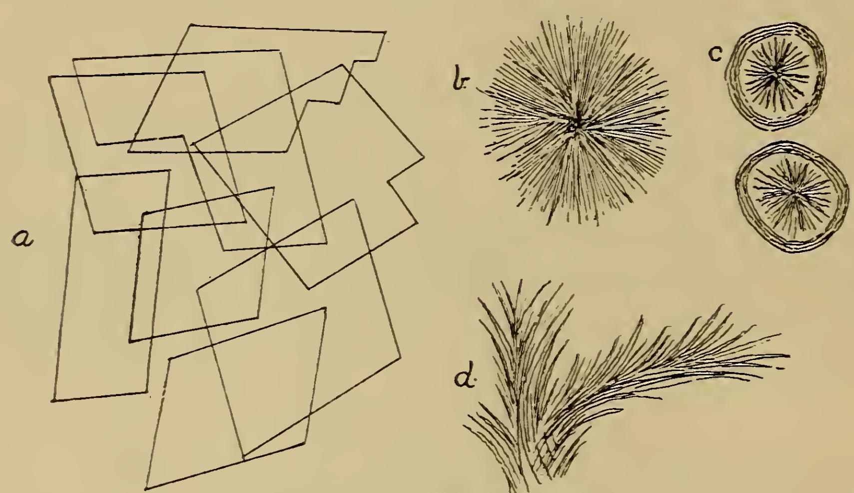
1. Fatty degeneration of the heart.
2. Acute yellow atrophy of the liver.
3. Chronic parenchymatous nephritis.
4. Cholesterin plates and margaric acid crystals.

In fatty degeneration there is a change of the albuminates into fat, this change often being preceded by one of cloudy swelling. The most marked examples of fatty degeneration are to be seen in the organs of pernicious anæmia. Here there is a marked diminution in the normal supply of oxygen to the parts, on account of the

diseased condition of the red blood-corpuscles. Fatty degeneration is also seen in chloroform narcosis, the degeneration of the heart muscle occurring at times in the course of a few hours. Artificial fatty degeneration is produced abroad in the livers of geese and ducks, for the sake of producing a delicacy known as pâté de foie gras. It is brought about in these animals by the administration of the salts of antimony, by lack of exercise and over-feeding.

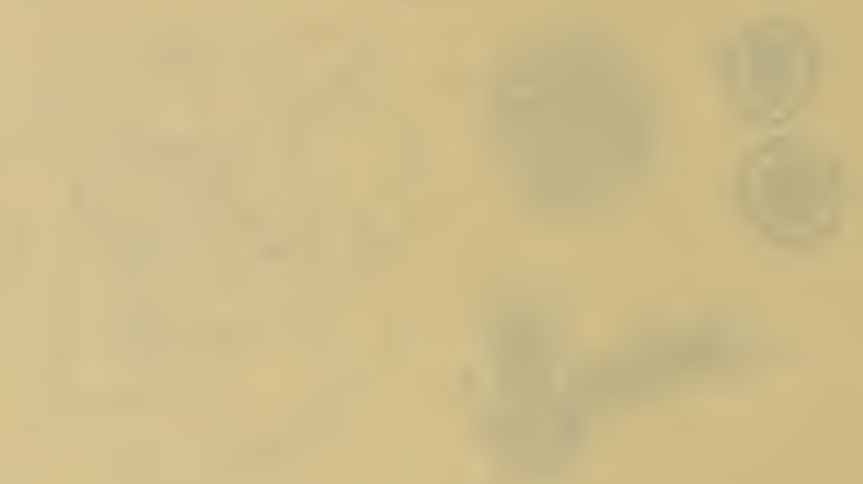
The final product of fatty degeneration is frequently cholesterin, compound granule cells and crystals of margaric acid—probably a mixture of palmatic and stearic acid, but by some recent observers supposed to be a definite chemical compound, melting at about 60° C. (See Fig. 14.)

Fig. 14.



Fat crystals. × 300. (Ziegler.)
a, Cholesterin plates. *b*, Tuft of margaric acid crystals. *c*, Tuft of margaric acid crystals enclosed in fat cells. *d*, Feathers of margaric acid crystals.

Fat, as it normally exists in the human body, is a mixture of olein, palmatin and stearin. Olein is fluid at the ordinary temperature of the body, while palmatin becomes fluid at 46° C., and stearin at 53° C. The cells in fatty degeneration contain fat in a more finely divided state than in fatty infiltration, where the droplets are apt to run together into one large drop. Fatty degeneration follows the administration of a number of poisons, such as phosphorus, iodoform, arsenic, sulphuric acid, nitric acid, etc. Exhausting disease, such as phthisis, leucocythæmia, and Addison's disease, especially give rise to it. It may follow scarlet fever and various other septic conditions. The prolonged use of alcohol may also produce it. A nerve, when cut off from its



trophic centres, undergoes a secondary degeneration, which is really nothing more than a fatty degeneration.

An examination of the muscular papillæ of a fatty degenerated heart shows numerous small, creamy-colored areas, which stand out prominently from the anæmic or reddish-brown areas. This has been compared to the variegated appearance of the breast of a

FIG. 15.

Fatty degeneration of musculus papillaris. (HAMILTON.)

thrush or to faded leaves. (See Fig. 15.) In advanced cases, however, the degeneration may be so marked that the heart muscle is of the color of a fatty liver. In septic conditions small hemorrhages will often be found beneath the epicardium. The heart muscle itself is flabby and in some cases very friable.

Amyloid Degeneration.

No physiological example.

1. In liver, spleen, kidney, etc.
2. In nervous tissue, prostate, etc.

3. Artificial amyloid reaction.
   Sago spleen.
   Iodine reaction.

Exhibits.

1. Amyloid liver.
2. Section from amyloid liver stained with gentian violet.
3. Sago spleen.
4. Sago spleen acted upon by Lugol's solution.
5. Picture of artificial amyloid degeneration.
6. Amyloid bodies in prostate.

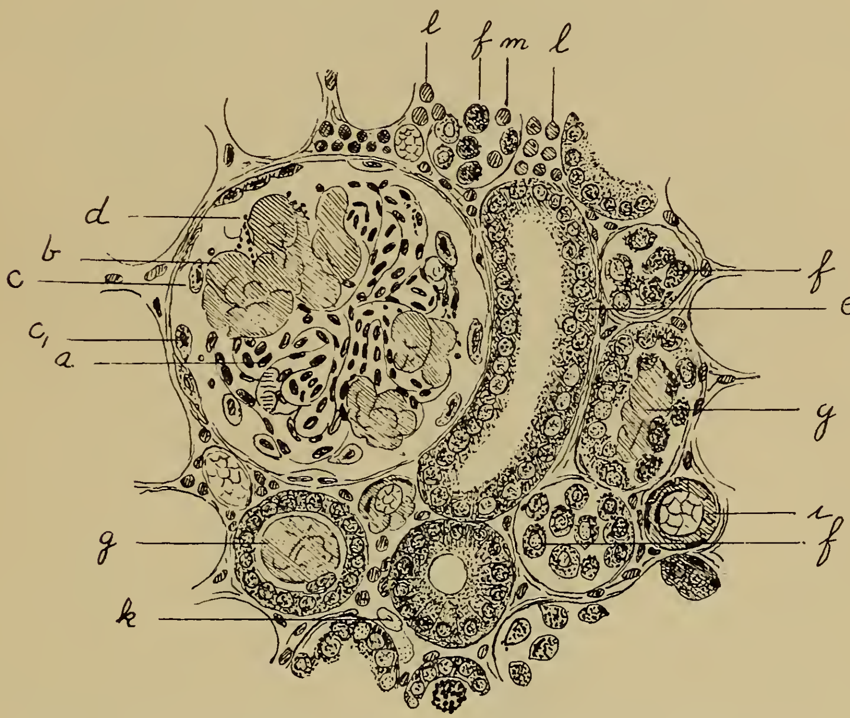
Fresh specimens.

Amyloid degeneration is especially apt to occur in constitutional wasting diseases, such as syphilis and tuberculosis, especially if they be accompanied by a running sore from a bone lesion. A spleen affected with amyloid degeneration is called a sago spleen, because the Malpighian bodies are greatly enlarged and stand out prominently upon the true splenic tissue, looking like boiled sago sprinkled on fresh-cut beef. You may have amyloid degeneration of the spleen without having the characteristic appearance of the sago spleen. There is no such thing, however, as a sago liver or kidney. It is at times impossible to detect amyloid degeneration in an organ without proper staining. The waxy liver is so called on account of its resemblance to smoked ham or salmon, or boiled bacon fat. All parts of the organ are equally enlarged; giving a square appearance to the organ. The edges are rounded, though not as markedly as in a fatty liver. The capsule is translucent, smooth, and thin, the organ seeming to stretch it. To the touch the substance is firm and hard, resembling a piece of India-rubber. The amyloid liver may reach an enormous size and weigh from twelve to sixteen pounds or more. If a nerve tissue, such as a spinal cord, be hung up in spirit for any length of time, you may have the production of amyloid bodies which cannot be distinguished from those which occur in certain diseased states. The term artificial amyloid has been, therefore, given to this condition, and

no doubt many cases which have been described in the nervous system were due to the artificial variety. Amyloid means, like starch, because if sulphuric acid be added to these bodies, and then an aqueous solution of iodine, in potassium iodine, a blue color is produced. (See Fig. 16.)

The best test for amyloid degeneration is found in the application of Lugol's solution, which is prepared with one part of iodine,

FIG. 16.



Section of an amyloid kidney, treated with Müller's fluid, prussic acid, and methyl violet. × 300. (ZIEGLER.)

a, Normal capillary loop. *b*, Amyloid capillary loop. *c*, Fatty epithelium of the glomerulus. *c*, Fatty epithelium of the capsule. *d*, Oil-drops on the capillary wall. *e*, Fatty epithelial cell *in situ*. *f*, Loosened fatty epithelial cells. *g*, Transverse section of a hyaline cast. *i*, Amyloid artery. *k*, Amyloid capillary. *l*, Infiltration of connective tissue, with leucocytes. *m*, Round cells (leucocytes) inside a uriniferous tubule.

two parts of the iodide of potassium, and seventeen parts of water. You cut and wash with water a thin strip from the organ to be examined, and, placing this strip upon a dish, you cover with water and then add a few drops of Lugol's solution at a time until the tissue is lightly stained. On examination, by a good light, you will find that the portions of the tissue affected with amyloid degeneration will have a red mahogany-brown coloration entirely different from the stain which the iodine will give to the tissue if the amyloid degeneration has not taken place. This color is difficult to describe, and should be seen to be appreciated.

Hyaline Degeneration.

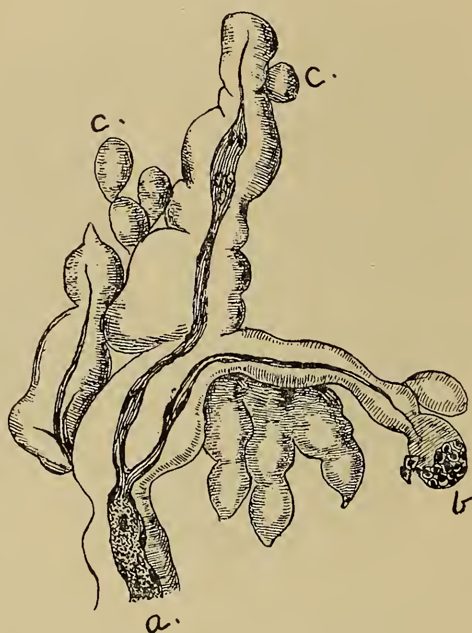
Synonyms: Vitreous, glassy, degeneration.

Exhibits.

1. Picture and slide of a small artery affected with hyaline degeneration.

Small arteries, capillaries, and minute veins may form a translucent substance closely resembling the material formed by

Fig. 17.



Hyaline bloodvessels in a cylindroma. (Ziegler after Sattler.)
a, Small bloodvessel. *b*, Patch of epithelial-like cells on one of the hyaline appendages, *c*.

amyloid degeneration, but not characterized by its reactions. The calibre of the vessels may be diminished, or even obliterated.

Parenchymatous Degeneration.

Syn.: Cloudy swelling.

Exhibits.

1. Slide of kidney showing cloudy swelling.
2. Slide of kidney showing the cells acted upon by acetic acid.

Epithelial cells, which have much to do with secretion and excretion, and muscle cells, are especially affected. The soluble

albumin is precipitated in the cell as a finely granular, insoluble albuminate, this condition often being the precursor of fatty de-

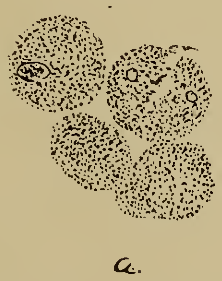
FIG. 18.

Cloudy swelling of renal epithelium. Preparation treated with chromic acid and ammonia. × 800. (ZIEGLER.)

a, Some of the epithelial cells are normal, others show commencing cloudy swelling. Remember that normally the epithelial cells are somewhat granular. *b*, Advanced degeneration. *c*, Loose degenerate epithelium.

generation. (See Figs. 18, 19, and 20.) Hyperpyrexia is the chief cause, though agents, such as phosphorus, which may produce fatty

FIG. 19.



Cloudy swelling of liver cells. × 350. (HAMILTON.)

FIG. 20.

Same treated with acetic acid. × 350. (HAMILTON.)

degeneration, can also give rise to this condition. In scarlet fever there may be no or little fever, and yet cloudy swelling may be

produced in the kidney. The cell or fibre becomes swollen, and the granular condition may hide the nucleus of a cell or the tissue striæ, if it be a muscle. Acetic acid or sodium hydrate will quickly dissolve the precipitated material in the cell, and the protoplasm, with its nucleus, will again appear clear and transparent. A heart affected with cloudy swelling looks like a normal heart viewed through smoked or ground-glass.

It must also be borne in mind that certain methods of preparing tissues for microscopic study may either produce or destroy this form of degeneration.

Serous Degeneration.

This form of degeneration is especially apt to occur in epithelial cells and in muscle, when these tissues have been deluged for a long time with the modified lymph found in serous infiltration. A viscid material collects in the cell, and there is seen a peculiar vacuolation of the protoplasm.

Mucoid Degeneration.

Phys. ex.: Vitreous humor; jelly of Wharton.

Pathologically, this condition is especially apt to occur in connective tissue.

Path. ex.: Tumors.
Myxœdema, cretinism.

Exhibits.

1. Myxomatous polyp of the nose.
2. Picture of a cretin.
3. Picture of a case of myxœdema.
4. A fibro-lipoma undergoing myxomatous degeneration.

In **mucoid** or **myxomatous degeneration** you have the formation of a definite chemical substance known as **mucin**. This substance is in the possession of certain characteristic chemical tests, and can be estimated quantitatively.

Dogs and cats usually live but a short time after the removal of the thyroid gland. In man, after the removal of a goitre or of the thyroid gland, a peculiar condition known as **cachexia**

strumipriva is produced. This condition consists in the deposition of mucin in the subcutaneous connective tissue and a thickening of the integument throughout the body. The features become dull and sodden, and the size of the digits is increased. The memory becomes poor and mental aberrations may come on.

It was found that if a portion of the gland was left behind, or if there was an accessory gland, this condition did not occur.

Horsley was the first to suggest that the thyroid gland of an animal, such as the sheep, should be either introduced into the abdominal cavity or else introduced beneath the skin, when there was an absence or had been surgical interference with this gland.

For a short time there followed an amelioration of the physical and mental condition of the patient, but soon the gland atrophied and the condition of cachexia strumipriva returned. Next an extract from the gland was prepared and introduced subcutaneously, or the person was fed with specially prepared thyroid glands of the lower animals. An amelioration of the symptoms has occurred in some cases.

It would, therefore, seem that the thyroid gland either destroys a poison that is circulating in the system, or else that it elaborates a chemical substance that is necessary for the proper maintenance of health in the body, or to counteract a poison circulating in the body.

Myxœdema is especially found in the Alps, and it has been supposed by some observers to be due to the drinking of glacial water. This water is of a light-blue color, and the presence of a micro-organism has possibly been demonstrated, and this is supposed by some writers to be the cause of myxœdema and the allied condition—cretinism—a congenital form of myxœdema.

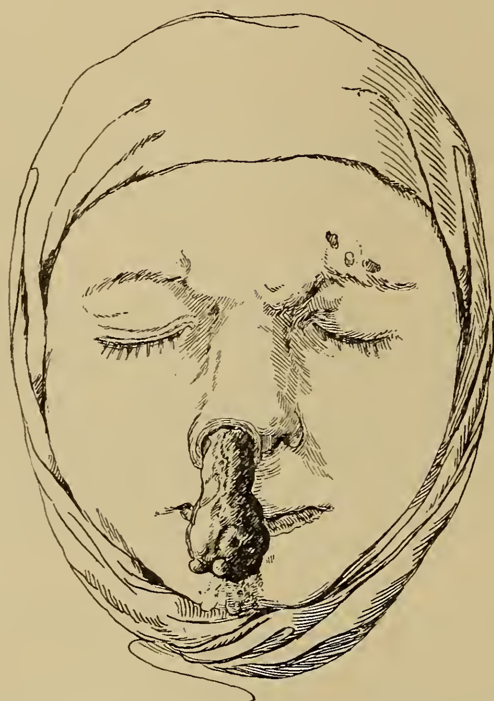
Vaughan has shown from his investigations that an extract of the thyroid gland is detrimental to the growth of bacteria. It would, therefore, seem probable, or at least possible, that the toxine of a micro-organism is rendered inert in the thyroid gland, or else that a chemical substance is there formed which is capable of counteracting the deleterious effects of a poison elaborated by some micro-organism or other.

This form of degeneration appears as a jelly-like substance, even more so than in the colloid form of degeneration.

Fibromas, sarcomas, lipomas, and chondromas are especially liable to undergo this form of degeneration. (See Fig. 21.)

In a sarcoma which has undergone myxomatous degeneration the mucoid material is usually collected in spaces, portions of the tumor being unaffected. The connective tissue cells are usually not

FIG. 21.



Myxomatous polyp of the nose. The tumor is sessile and very vascular. Pus is running down over the lips, and auto-innoculation is seen on the forehead. (From a wax model in the Wistar and Horner Museum.)

attacked, and can be seen standing out prominently in the jelly-like substance; later on, however, the connective tissue cells themselves may become involved. The adventitia of small arteries is especially affected.

Colloid Degeneration.

Ex.: Cancer.

Here the cellular structures, especially if epithelial in their nature, become converted into a structureless, semi-solid substance of homogeneous jelly-like consistency not containing mucin.

The closure of a duct lined with epithelial cells may lead to this condition, as is frequently seen in the kidney. It would seem as if the epithelial cells themselves were converted into the colloid material. It is so frequently seen in the thyroid gland after forty that it cannot be considered as pathological after this age. It is

found in cancerous and cystic ovarian tumors. The chemical composition of the colloid material is very uncertain.

This form of degeneration may take place in the muscles in typhoid fever, the resemblance to the uncooked muscle of fish being striking.

Necrosis.

I. True: direct, macroscopic. Ex.: Gangrene of foot or arm.

II. Necrobiosis: indirect, microscopic. Ex.: Pus.

Terminations: Absorption, retention, thrown off, regeneration, cicatrization.

Line of demarcation. Line of separation.

I. Coagulation Necrosis.

Phys. ex.: Coagulation of blood.

Path. ex.: Diphtheria.

Diphtheria and true croup have the same cause, but have different anatomical situations.

II. Liquefaction Necrosis.

Ex.: Blister.

III. Cheesy Necrosis, or Caseous Degeneration.

Ex.: Tuberculosis.

IV. Gangrene.

Phys. ex.: Umbilicate cord.

1. Dry gangrene, or mummification. Arteries affected.
2. Moist gangrene, or sphacelus. Veins affected.

Senile gangrene. Raynaud's disease, or symmetrical gangrene.

Causes. Common: Ergot, diabetes. Rare: Antipyrin, carbolic acid.

Fresh specimens.

Exhibits.

1. Dry gangrene of the foot.
2. Pus.
3. Slide showing streptococci in pus.
4. Diphtheritic membrane of the larynx.
5. Pseudo-membrane produced by steam.
6. Dysenteric ulcer.
7. Tubercular cavity.
8. Moist gangrene of the foot.

Every living cell must sooner or later cease to exist. In the living body cells are constantly dying and being replaced by cells of a like kind. It is only, therefore, when these cells die in abnormal numbers that we have the pathological condition of necrosis.

Necrosis is the local death of a cell or of a group of cells in the midst of the living cells of the body.

You have two varieties. The first, which is known as true or direct, is macroscopic in its nature. This is illustrated by a case where we have a large number of cells dying at once, as is seen through mechanical, chemical, thermic, and anæmic changes.

In necrobiosis, or the indirect form, you have individual cells dying slowly, these cells being first affected with one or more of the elementary retrograde morbid processes. This form is best studied under the microscope.

It may happen that by means of one or other of the degenerative processes the dead cells may be so acted upon and so finely divided and emulsified that each individual particle is capable of being removed from the situation where the cells have died. The formation of this material is known as molecular débris. If the dead body, which has now become a foreign body, is unable to be so acted upon, there may be a reaction in the healthy tissue of such an extent that a wall may be thrown around the foreign body which completely encapsulates it and prevents the dead area from being any damage to the living tissue. This wall may afterward undergo calcification. This is more markedly observed in those cases where a parasite gains access to the tissue, as is seen in the case of the trichina spiralis, where the vitality of the parasite is such that it is capable of living for years in the tissue without dying, or

when a large foreign mass, such as a fœtus in the uterus, undergoes retrograde changes and becomes necrotic and calcified.

The foreign body may be thrown off in mass, as is seen sometimes in a toe or foot becoming gangrenous and separating from the body.

In regeneration, it should be remembered, every cell comes from a pre-existing cell, this cell being of a nature similar to the one destroyed. If the cell be a simple connective tissue cell its place can easily be taken by another cell of a like character. If the connective tissue cell is more highly specialized, as is seen in the case of bone and cartilage, the cell may be but imperfectly formed, as is seen in a chondroma or an osteoma. If, however, the cell be a highly specialized one, as in the retina of the eye, Nature is unable to produce a cell as good as the one which is destroyed, and an inferior cell takes its place; hence it is that when a large portion of an organ has been destroyed, or a number of highly specialized cells, we have a connective tissue formation which, as age advances, contracts and a cicatrix is produced.

The line of demarcation is where the battle is going on between the dead and the living cells. This line is irregular and is constantly advancing and receding. This line has a twofold object: it may prevent the invasion of detrimental cells, toxines and bacteria into the healthy tissues beyond, or else take part in regeneration. The line of separation is where the dead tissue is to leave the living, and is on the distal side of the line of demarcation, occupying the place where the line of demarcation formerly was.

Coagulation Necrosis.

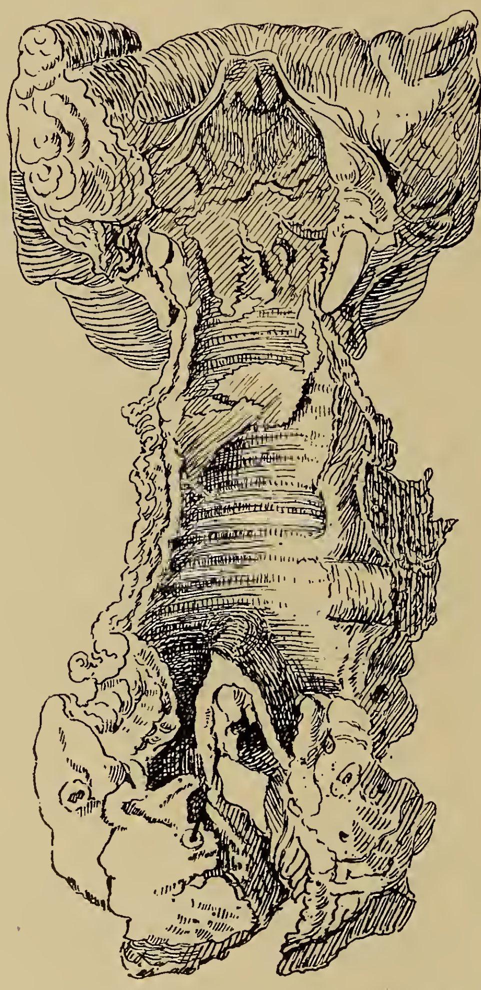
A physiological example of coagulation necrosis is seen in the coagulation of blood; fibrinogen, fibrino-plastin, and the ferment being the prime factors.

Typical pathological examples of this condition are to be found in a diphtheritic membrane and in dysenteric ulcers. In diphtheria the pseudo-membrane which is produced on the mucous membrane will differ in its macroscopic appearance according to its anatomical situation. The tissues of the tonsils, palate, and pharynx being softer than of the larynx and trachea, there is given a more favorable opportunity for the fibrin to penetrate into the surrounding tissue, and for the micro-organisms and their toxic

products to thus readily gain access to the system through the adjacent lymphatics. (See Fig. 22.)

It should be remembered that the mucous membrane of the nose, the conjunctiva, the urethra, the bladder in exstrophy, etc., may become primarily or secondarily affected, and show the diphtheritic membrane. The cause of the production of fibrin in

Fig. 22.



Pseudo-membrane (diphtheritic) of the epiglottis, vocal cords, and larynx. The calibre of the larynx is diminished, and the membrane, composed largely of fibrin, is but slightly adherent to the dense tissues beneath. The cause is the Klebs-Löffler bacillus. You might not be able to tell this membrane in the larynx from that caused by certain poisons or by the inhalation of steam. (Drawn from a specimen in the Museum of Morbid Anatomy.)

diphtheria is the Klebs-Löffler bacillus. A pseudo-membrane in the intestinal tract is sometimes called diphtheritic when not due to the action of this bacillus. Weigert's special stain for fibrin will give a blue color to the fibrin under the microscope.

Coagulation necrosis is also seen after the ligation of a bloodvessel and in embolism.

Liquefaction Necrosis.

The protoplasm, but more especially the intercellular substance, is converted into a liquid. This condition may either precede or follow coagulation necrosis. Familiar examples of liquefaction necrosis are seen in the blebs after a burn or after the use of cantharides. Thrombi are largely removed by this process of liquefaction necrosis.

Cheesy Necrosis or Caseous Degeneration.

By means of a form of fatty degeneration induced by the action of certain poisons, especially those elaborated by certain micro-organisms, there is produced either a dry or moist form of necrosis resembling that seen in coagulation necrosis, but not containing fibrin. The dry form is frequently seen in the encysted and calcified nodules in a tubercular lung; also in dermoid cysts. One form may be converted into the other.

Gangrene.

Among the lower animals the mother may bite off the cord from her offspring. This laceration of the bloodvessels produces a coag-

Fig. 23.

Hand affected with dry gangrene, showing mummification.
(Photographed by Dr. Robert Formad, from a specimen in the Wistar and Horner Museum.)

ulation necrosis inside of the bloodvessels. A line of demarcation is quickly produced. The process does not get beyond the living cells in the region of the umbilicus if no micro-organisms gain access to the part. In a newborn child examine not only for signs of inflammation following the vessels going up toward the liver, but also down along the course of the hypogastric arteries.

Dry gangrene is especially apt to occur in those cases where an arterial collateral circulation is not capable of establishment, as in arterio-fibrosis. (Senile gangrene.) The part resembles the condition produced by embalming and age in a mummy. (Fig. 23.) In moist gangrene the liquid is prevented from passing out by means of pressure on the veins and lymphatics. One form of gangrene may pass into another, as is seen where an abrasion of the skin in moist gangrene allows the evaporation of the fluid and the dry form is produced. The term sequestrum is employed for the detached portion of the separated bone.

Raynaud's disease is due probably to nervous influences. The appearance of the extremities is like that seen when a person has taken a long walk in the cold and then exposed himself to a warm fire.

The physiological effect of ergot is such that a contraction of the arteries follows its use. In France many of the inhabitants of entire villages have been affected with gangrene from the use of rye bread, due to the sclerotium (spawn) of the claviceps purpurea developing within the paleæ of the rye.

When antipyrin was first introduced it was employed in such large doses that its hæmostatic properties produced gangrene in certain cases. Several of the French surgeons have lost their fingers from gangrene from the repeated use of strong solutions of carbolic acid.

Local Hyperæmia.

Phys. ex.: Blushing.

1. Active, congestive or arterial. Higher temperature.
    - *a.* Idiopathic.
    - *b.* Collateral.
2. Passive, venous or static. Lower temperature.
    - (After death may become red, due to oxidation of the hæmoglobin.)
3. Post-mortem lividity, or hypostatic congestion.
    - *a.* Pressure dispels color.
    - *b.* Bleeds when cut.
    - *c.* Not elevated above surface.
    - *d.* Depends on position of the body.
    - *e.* Extends over more surface.
    - *f.* Shows frequently a mottled appearance.

Local Anæmia or Ischæmia.

Artificial ischæmia.

Difference between thrombosis, thrombus, embolus, and embolism.

Thrombosis.

Varieties of thrombi:

A. 1. Primary or primitive; 2. Secondary or produced.

B. Venous, arterial, cardiac, capillary, lymphatic.

C. 1. Parietal; 2. Obstructing or obliterating; 3. Valvular; 4. Channelled.

D. Septic, marasmic, organization of, calcification of, softening of.

Clots:

1. Chicken-fat. 2. Stratified or mottled. 3. Currant-jelly.

Embolism.

Varieties of emboli:

Usually a portion of a thrombus. May have also air, fat, pigment, micro-organisms, portion of a valve or tumor, etc.

Hemorrhage.

1. Arterial. 2. Venous. 3. Capillary. 4. Parenchymatous.

Hemorrhage from free surfaces:

a. External. Ex.: Hæmaturia.

b. Internal. Ex.: Hæmopericardium.

Hemorrhage into the tissues:

a. Petechiæ.

b. Hæmatoma.

c. Extravasation.

Hæmorrhagia per rhexin.

Hæmorrhagia per diapedesis.

Hemorrhagic Infarct.

Anæmic Infarct.

Fresh specimens.

Exhibits.

1. Hypostatic congestion of the cadaver.
2. Thrombosis of the umbilical vessels.
3. Thrombus in an aneurismal sac.
4. Chicken-fat clots.
5. Stratified clots.
6. Currant-jelly clots.
7. Hæmatoma.
8. Embolism of the brain.
9. Hemorrhagic infarct of the lung.
10. Anæmic infarct of the spleen.

By **local hyperæmia** is understood that there is an excess of blood in any part of the body. A physiological example of this condition is seen in the sudden dilatation of the capillaries in blushing. After death an extensive hyperæmia, plainly visible during life, may have entirely disappeared in certain parts of the body. This is due to the fact that the bloodvessels, especially the arteries and capillaries, have been emptied by the contraction of their walls and the pressure brought about by the coagulation of certain substances in the tissue in which these vessels run.

Active hyperæmia consists in an increased amount and an accelerated flow of blood by means of the arteries into a part, it either being due to the fact that there is an increased blood-pressure or a diminished resistance. It is either idiopathic, where the cause lies in the relaxation of the muscular walls of the arteries themselves, or else it is **collateral** (compensatory), where anæmia of an organ or portion of an organ causes more blood to go to another part than normally belongs there. For example, if the right renal artery should be pressed upon by a tumor, the kidney on this side would become anæmic and an excess of blood would find its way into the left kidney, which would then be said to be affected with collateral hyperæmia.

Owing to the fact that there is more warm arterial blood in the part, the temperature will be higher. This may also be due in part to increased chemical and mechanical changes along with increased heat dissipation.

In **passive or static hyperæmia** the veins are filled with venous blood due to the natural lack of elasticity in their walls, not being able to overcome a pressure exerted on the veins above.

It should be remembered in this connection that the venous blood is capable of being converted into arterial blood when exposed to the action of the air. This is frequently seen at a post-mortem when you have made a section into an organ such as a passive congested spleen, and have then allowed the organ to be exposed to the air; the color may quickly change from the purplish hue of venous blood to the scarlet hue of arterial blood, due to the oxidation of the hæmoglobin. The temperature is here lowered.

In **post-mortem lividity** or **hypostatic congestion** you have a hyperæmic condition of the cadaver. It is sometimes necessary to distinguish this condition from an extravasation of blood. In hypostatic congestion you will find that pressure will expel the blood and the part will bleed when cut. This is not so in extravasation, for the blood has coagulated and cannot escape from the part. In an extravasation you will find that the part affected is elevated above the surrounding part and is not so extensive, neither does it present the mottled appearance so characteristic of cadaveric lividity. The best means of telling, however, is the position of the body, the blood gravitating toward the dependent portions of the body, those portions where the body rests on the table not being affected. Turn the body from its back over on the abdomen and the blood will gravitate to this region.

The use of the word **anæmia** is one to which many meanings have been attached. It denotes a diminution of the amount of blood in the entire body when such reduction is below the normal of one-thirteenth of the body weight. This condition is better known as oligæmia. It is also used to denote a condition of the blood in which there is a diminution of the number of the red blood-cells (oligocythæmia) or else an actual diminution in the amount of the hæmoglobin.

By **ischæmia** is understood that there is a diminution of the amount of blood in a part or a portion of a part. By **artificial ischæmia** is understood that blood has been removed from the part by means of external applications, as seen in the lower limb when an Esmarch's bandage has been applied.

By **thrombosis** is understood the act or condition of the deposition of fibrin in the veins, arteries, capillaries, heart, or lymphatics. That which is formed and really seen is known as the **thrombus**, though other elements than fibrin may enter into its composition.

By **embolus** is understood the circulation of a foreign material in one of the circulatory streams of the body and its lodgment

in a vessel or part which will not permit of its further passage. It does not necessarily follow that the embolus will go in the direction of the current; in the veins a backward flow has been observed. An embolus is usually a portion of a thrombus. When the embolus has lodged, the obstruction of the vessel and the co-existing condition of thrombosis is described as **embolism.**

An example will perhaps best make this clear. At a post-mortem it was found that fibrin had been deposited in the left auricular appendix; the act of forming the fibrin is known as thrombosis, while that which was formed is the thrombus; this thrombus, in which the presence of micro-organisms was demonstrated, had undergone liquefaction necrosis, and a small portion was carried through the auriculo-ventricular opening into the left ventricle, from thence into the aorta and then down to the radial artery. During the time that it was circulating in the arterial stream it was an embolus; as soon as it plugged up the radial artery the condition of embolism was produced by a further deposition of fibrin in this situation by means of thrombosis. Interference with the arterial blood-supply caused a variety of dry gangrene. In the spleen and kidneys emboli plugged up terminal arteries and we had hemorrhagic infarcts.

According to the circulatory stream in the body in which you have the deposition of fibrin, the name of venous, arterial, cardiac, or lymphatic thrombus is applied.

A primary or primitive thrombus is one in which the original seat of the deposition of fibrin is designated. By a secondary or produced thrombus is meant the superaddition of fibrin until the first main branching vessel is reached. A rounded end, tapering off, usually floats in the stream and may then become attached to the wall with the production of a primary thrombus in this situation, and the formation of a secondary thrombus to the next branching vessel. (See Fig. 24.)

The parietal thrombus is one in which fibrin is deposited upon a portion of the wall of the vessel; if the vessel be entirely closed it is called an obstructing or obliterating thrombus. This condition is seen after the ligature of a bloodvessel.

The valvular thrombus, as the name implies, has a valvular arrangement of the thrombus permitting the passage of blood when the pressure is increased and hindering its backward flow.

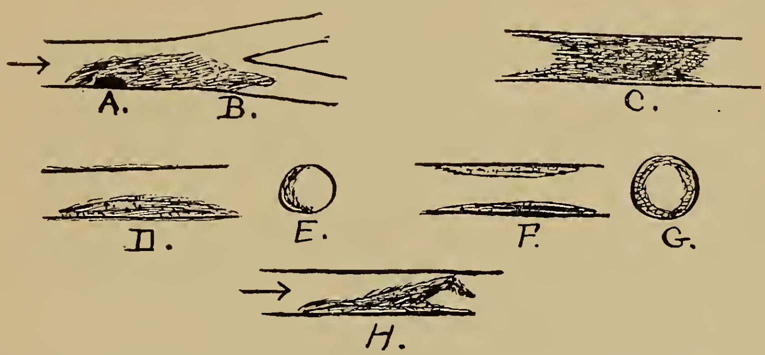
The channelled thrombus is either a complete parietal thrombus or else an obstructing thrombus in which a portion has been re-

moved and the stream is able to continue in its onward course. (See Fig. 24.)

A thrombus may organize, the new bloodvessels originating from the walls of the vessel in which the thrombus is found, and extending by means of capillary loops into the new mass; calcification may set in or liquefaction necrosis may occur, the latter especially if there be septic or micro-organismal invasion.

In certain weakened states, as from excessive hemorrhage or starvation, fibrin may be readily deposited, and we have what is known as a marasmic thrombus.

FIG. 24.



A. Primary thrombus. B. Secondary thrombus; the arrow represents the direction of the current. C. Complete or obstructing thrombus. D. Parietal thrombus, longitudinal section. E. Parietal thrombus, transverse section. F. Circular thrombus, longitudinal section. G. Circular thrombus, transverse section. H. Valvular thrombus.

Clots are of three kinds, **chicken-fat, stratified or mottled,** and **currant-jelly.** It is usual to see a combination of all three at once; the older the clot the more fibrin it contains and the more firmly adherent it is to the vessel wall. Chicken-fat clots are best seen in death from croupous pneumonia and in opium poisoning.

An embolus is most frequently a portion of a thrombus. Air may be introduced into a vessel by means of an accident or by the hypodermatic needle. In a case of fracture, fat may also gain access. A portion of a valve—for example, in ulcerated endocarditis—or a tumor growing into the vessel or from the vessel wall, may become an embolus.

By **hemorrhage** is understood an escape of blood from the heart or the bloodvessels, either externally or into or between the tissues (Foster). It may be either **arterial, venous,** or **capillary.** These names explain themselves. By **parenchymatous** is understood a combination of the first three mentioned varieties.

A hemorrhage may be from a free surface, which is either ex-

ternal or internal; for example, hæmaturia, in which the blood appears in the urine, having escaped from some point along the urinary tract; epistaxis, where the bleeding is from the mucous membrane of the nostrils; hæmoptysis, from the lungs; hæmatemesis, vomiting of blood from the stomach; metrorrhagia, a hemorrhage from the uterus not due to the menstrual discharge; menorrhagia, excessive menstrual flow; vicarious or supplementary hemorrhage, a hemorrhage from some portion of the body other than the uterus, taking the place in part or wholly of menstruation; post-partum hemorrhage, bleeding after childbirth not due to laceration; post-mortem hemorrhage, exudation of blood into the surrounding tissues due to the fact that the blood has undergone decomposition.

A collection of blood from an internal surface into the uterus is named hæmatometra; into the thorax, hæmothorax; into the tunica vaginalis of the testicle, hæmatocele; into the pericardium, hæmopericardium.

If the hemorrhage into the tissue be small and the areas well circumscribed, they are called petechiæ or ecchymoses; if it forms in large amount it is known as a suggillation; and if a tumor or swelling is produced it is called a hæmatoma.

The blood may escape by a break in the continuity of the vessel wall—hæmorrhagia per rhexin, as is seen in the rupture of a cerebral artery in apoplexy. The blood may also gradually escape directly through the vessel wall, especially through the stomata or openings left by the junction of the endothelial cells lining the bloodvessels; this is called diapedesis.

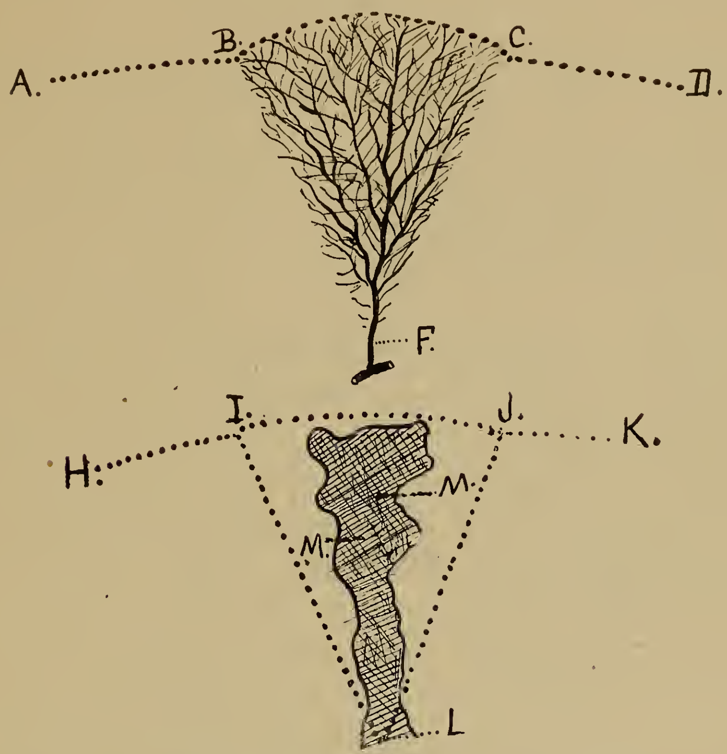
By **hemorrhagic diathesis** or **hæmophilia** is understood the peculiar tendency exhibited by some persons to bleed upon the slightest provocation; they are familiarly known as "bleeders."

By **infarction** is understood the plugging up of a terminal bloodvessel in such a manner that there is an extravasation of blood, with the surrounding engorgement depending upon such obstruction.

By **hemorrhagic infarct** is understood the formation of a cone-shaped area of bloody infiltration, which upon section is wedge-shaped, raised above the surface of the organ with the base toward the periphery and the apex toward the entrance of the bloodvessel into the organ or part. The area is darker in color than the surrounding tissue, will frequently sink in water if it be lung, and is usually distinctly outlined from the surrounding tissue. The

artery affected is usually a terminal one. Hemorrhagic infarcts are especially liable to occur in the lungs, spleen, brain, and kidneys. (Fig. 25.)

FIG. 25.



Diagrammatic representation of a recent and old hemorrhagic infarct.

F. is a terminal vessel in which an embolus has lodged. Notice that the apex is toward the point of entrance of the vessel and the base toward the periphery of the organ. If the line A . . . D. represents the surface, B . . . C. is elevated above the surface, and while on section we have an angular appearance, the pathological condition is really one of a cone. In the lower figure M. represents connective tissue contracting and producing a cicatrix, the wedge shape no longer being demonstrable.

By **anæmic infarct** is understood the recent absence of blood in a conical area, or else the absorption and healing of a hemorrhagic infarct.

Inflammation.

Source 1. Diseased or dead cells.
2. Micro-organisms.

Usual form, combination of 1 and 2.

The clinical form (pain, redness, swelling, heat, and tendency to exudation), practically always due to micro-organisms.

Result, pus:

Laudable, sanious, ichorous, muco-pus, sero-pus, etc.

CHEMOTAXIS.

Positively chemotactic.	*Negatively chemotactic.*
Bacterial proteids.	Leucin.
Gluten, etc.	Tyrosin, etc.

Inflammation considered:

1. Clinically: Causes, symptoms, course, termination, and treatment.
2. Pathologically: Phenomena of function, nutrition, formation, and destruction.

The great factor: Cell action.

Terminations:

1. Sloughing or gangrene. Macroscopic.
2. Ulceration. Molecular or microscopic.

Septicæmia. } Clinical view.
Pyæmia.

Toxic septicæmia. } Experimental view.
Bacterial septicæmia.

Parenchymatous inflammation.

Exhibits.

1. Cultures of pus-producing micro-organisms: Staphylococcus pyogenes aureus. Bacillus pyocyaneus.
2. Various drawings illustrating inflammation.

Inflammation is the most important composite pathological process which we have to study in morbid anatomy. There is hardly a process which starts or ends a pathological change that has not inflammation as a factor at some time or other in its course. A clear conception of this subject, added to a full knowledge of the anatomy of the part and a good understanding of such conditions as the infiltrations and degenerations, will lead you most clearly to comprehend all special pathological changes.

* "Inflammation is the reaction of the parablastic tissues to the action of irritants when the reaction is attended with an overfilling of the bloodvessels with blood, a change in their walls, and an exclusion from them of a modified plasma and of leucocytes, and a proliferation of the connective-tissue cells. These changes

have for their object the removal or isolation of the source of irritation."

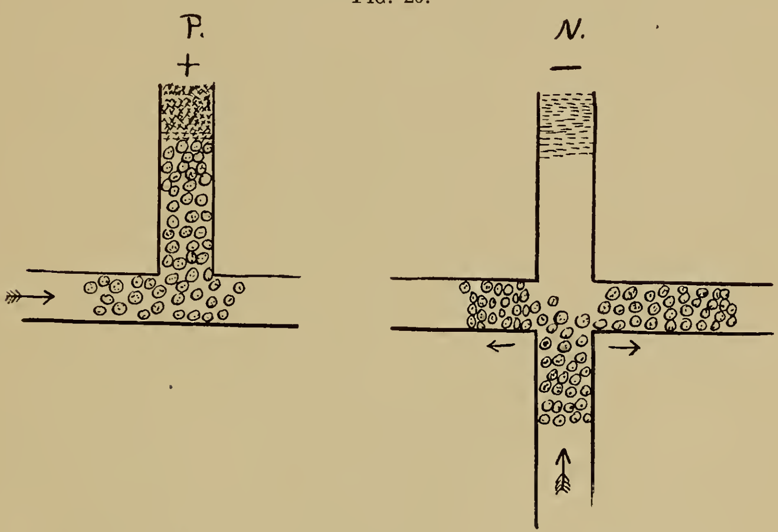
Sanderson describes inflammation as "a succession of changes which occur in a living tissue when it is injured, provided that the injury is not of such degree as at once to destroy its structure and vitality."

The source of inflammation is either diseased or dead cells or micro-organisms, or else a combination of both.

That the inflammatory process may be started without the presence of micro-organisms is shown, experimentally, when a portion of sterilized sponge or lung is introduced under antiseptic precautions into the abdomen of an animal. In the case of lung tissue, this being an organic tissue, we may have the structure entirely absorbed and an ordinary inflammatory mass left behind.

By **chemotaxis** is understood the property which certain chemical substances have of attracting (called positive chemotaxis) or repelling (negative chemotaxis) the cells. This is independent

Fig. 26.



Diagrammatic scheme to illustrate chemotaxis.

Notice that in the figure to the left you would naturally suspect that the leucocytes would continue along in the direction of the blood-current indicated by the arrow, but such is not the case; they are attracted toward the positively chemotactic substance in the upper portion of the connecting tube.

In the figure to the right, the leucocytes are repelled from the negatively chemotactic substance and will escape toward the right and left in the direction of the arrows.

of any vital force, and a force such as the attraction of gravity is capable of being overcome by certain products found in, or elaborated by, some micro-organism. Fig. 26 will perhaps best explain this subject of chemotaxis.

The clinical form, in which we have pain, redness, swelling, heat, and a tendency to exudation (dolor, rubor, tumor, calor of Celsus of the first century), is practically always due to micro-organisms or their products, and constitutes the variety which is described in works on surgery, and is the kind that you will be called upon to treat.

The pain is due to the fact that the exudate causes tension upon the terminal ends of the peripheral sensory nerves; the redness is due to the increased supply of blood to a part, with a diapedesis of the red blood-corpuscles; in cartilage, where there is but slight vascularity, there is but slight redness; the swelling occurs because there is more fluid in the part, containing leucocytes, micro-organisms and their products, connective-tissue cells, etc. The cause of the heat is a debated question; it is uncertain whether it is due to the fact that the arterial blood is there in larger quantity, or whether there is an increased chemical and mechanical change taking place in the part, or whether we have increased heat dissipation, or else a combination of these conditions. There have been many experiments made to ascertain the cause of the increased temperature, but these experiments seem frequently to contradict each other. Where the theories are so numerous one may be quite sure that a combination best explains the fact, or else that there is no satisfactory explanation for the phenomena.

We have produced in inflammation a substance known as pus. This has been described by various names which it is necessary for you to understand. The old idea of a laudable pus is that pus which is of a greenish hue, with not a bad odor, and which occurs in those cases which are apt to recover and in persons of a good constitution. We now know that pus is an unnecessary factor in the healing of wounds, and, therefore, there is no such thing as a healthy pus. Sanious pus is that form in which blood and pus are mixed in varying proportions, from the slightest tinge to that in which it is mostly blood. Then we have the ichorous pus—which is thin and acrid. We have also the muco-pus and the sero-pus, in which we have mucus or serum mixed with the pus.

Chemically, pus may be described as an albuminous fluid of a specific gravity varying from 1021 to 1042, containing the peculiar constituents of the tissue, whether they be cells, salts, or organic substances, with a mixture of leucocytes, micro-organisms, and certain chemical by-products, such as peptones, proteid compounds,

and leucin. (See Woodhead, p. 158.) If you open an acute abscess and examine the pus under the microscope, you will find a great number of leucocytes, and these leucocytes will be practically of one size. There will be a very few cells larger than the leucocytes, which are connective-tissue cells. If you will examine closely you will find that these leucocytes possess amœboid movement. You will sometimes be able, especially on a warm day, to examine the amœboid movement of the pus cells in urine very easily without the aid of a Stricker's warm stage. If acetic acid be added to the pus, we shall have a clearing up of the protoplasm and the appearance of a number of nuclei, showing that at some time or other in the life history of the cell, there had been an attempt at multiplication. When the pus is first being produced we have a number of micro-organisms present; but after a time the micro-organisms become rarer, and you should not be disappointed in opening a large abscess if you are not able to find any micro-organisms at all. You expect to find it loaded with various micro-organisms. But the micro-organisms have died, have undergone some form of necrosis and have been carried off. This is well illustrated in tuberculosis. You might not find the tubercle bacilli in the cheesy glands of the neck, even though you should scrape along the wall of the pyogenic membrane and should stain for them most carefully. How will you therefore demonstrate their presence? By taking some of the cheesy material and injecting it into a guinea-pig—an animal which is especially susceptible to inoculation by tubercular material—and allowing the bacillus to develop tuberculosis in the animal so injected.

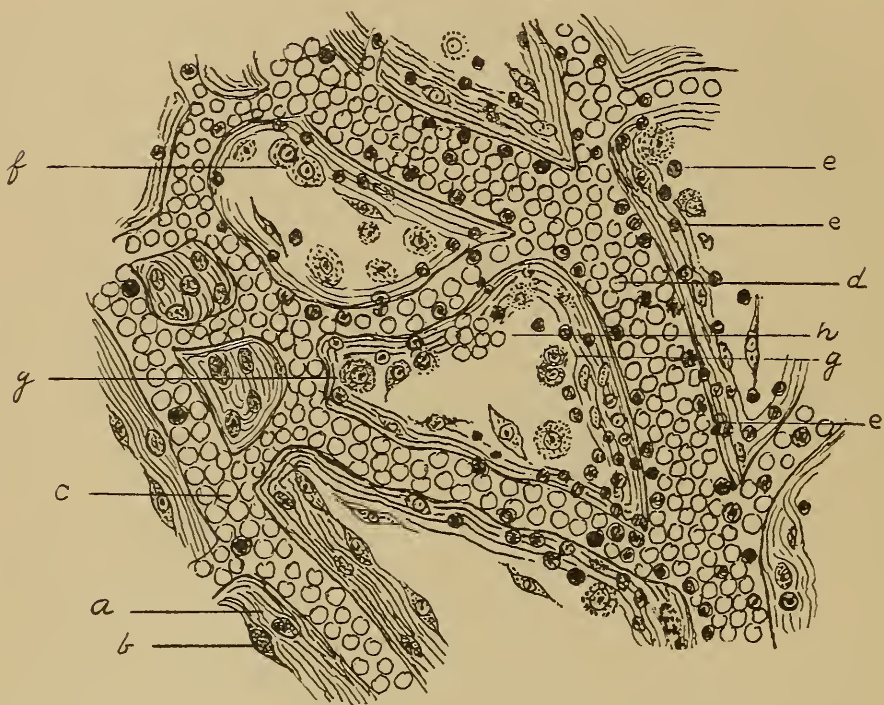
What micro-organisms are most frequent in the formation of pus? Many have been described. The list is a very long one and is steadily increasing. The way to remember them is simply to note that the names of such micro-organisms usually have the prefix pyo, which means pus; frequently pyogenes, pus-producing. They are also described in accordance with their color—citreus, albus, aureus, etc.; and by their shape—streptococcus, cocci in chains; staphylococcus, cocci in bunches like grapes, etc. But not all micro-organisms that are thus capable of producing pus have the prefix pyo. The bacilli of glanders and tuberculosis are cases in point.

The cholera bacillus does not produce pus. This is important, as the anti-vaccine of Haffkine is capable of being introduced into

man without fear of producing an abscess; only an indurated nodule is sometimes left at the seat of inoculation.

The source of the cellular element (Fig. 27) in inflammation is threefold: the outwandering of the cellular elements of the blood, this being preceded by the peripheral drift of the leucocytes; 2d, multiplication of the fixed connective-tissue cells and of the endothelial cells of the bloodvessels by means of a process of karyo-

FIG. 27.



Inflamed omentum from the human subject. (ZIEGLER.)

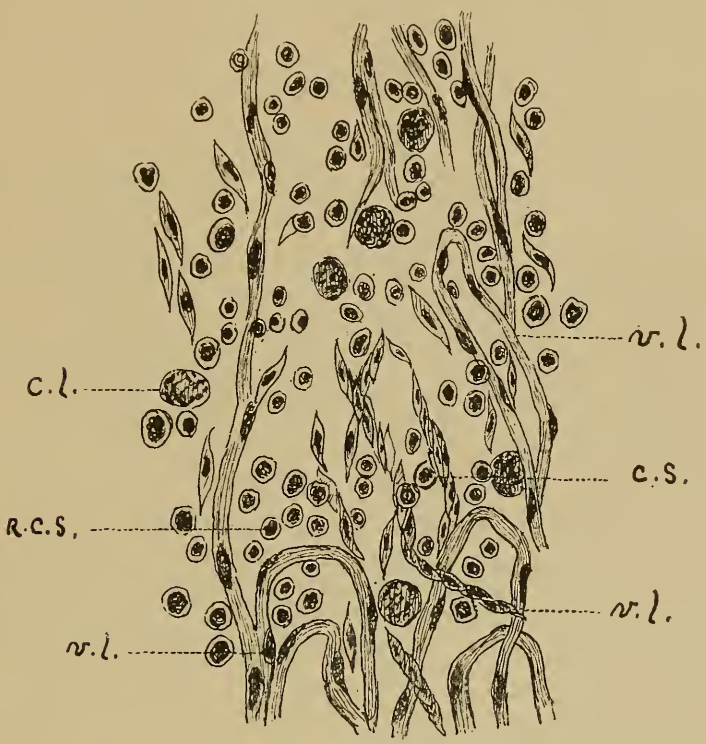
a. Normal fibrous trabecula. *b.* Normal endothelium. *c.* Small artery. *d.* Vein with white blood-cells peripherally disposed. *e.* White blood-cells migrated or migrating. *f.* Desquamated (multinuclear) endothelial cell. *g.* Desquamated endothelial cells. *h.* Migrated red blood-cells.

kinesis; and 3d, by the growing of cells or spores not capable of being demonstrated by the ordinary means when in a state of rest, but being brought into activity by means of the increased nutrition of the part, and the demand made upon the tissue for repair. If the leucocytes predominate, the retrograde changes are going on; if the connective-tissue cells predominate, the healing process is going on ahead of the destructive process; the latter cells may therefore be looked upon as repair cells. Fig. 28 illustrates the formation of the new bloodvessels.

By **pyæmia** is understood the circulation of the micro-organisms in the blood. By **septicæmia** that the products elaborated by the

micro-organisms at their seat of entrance circulate in the blood. There is often no sharp distinction between these conditions, and the use of the term **bacterial septicæmia** is preferable for the first condition and **toxic septicæmia** for the second. As an example we would cite an ordinary boil produced by a pyogenic micro-organism where a condition of miliary furunculosis followed.

FIG. 28.



Loops of bloodvessels in organizing tissue on a serous surface. × 300. (WOODHEAD.)

v. l. Loops of vessels fully formed, the structure of which is very readily observed.

c. s. Double rows of spindle-shaped connective-tissue cells from which the embryonic vessels are formed. Most of these cells are arranged with their long axes at right angles to the surface.

c. l. Large cells met with in all granulation tissue derived from connective-tissue cells.

r. c. s. Small round cells or leucocytes.

This is bacterial septicæmia. In tetanus the bacillus grows at the seat of inoculation, and the toxine circulates in the system and acts specially upon the nerve centres. An interesting fact in this connection is that surgeons found, for the prevention of tetanus, that wounds of the feet are best treated as open wounds. This is due to the fact that the bacillus of tetanus is widely distributed in the soil and is an anaërobic micro-organism, and when the wound is kept open to the air the bacillus is not capable of multiplying at the seat of entrance.

Tuberculosis.

Bacillus of. Lesions of.
Fresh specimens.

Exhibits.

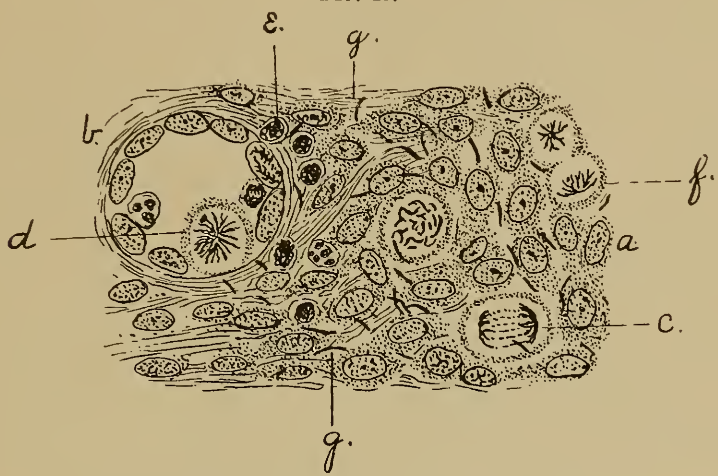
1. Pure culture of the tubercle bacillus.
2. Slide (under microscope) showing bacilli taken from the above.
3. Slide (under microscope) showing sputum, containing bacilli, stained with carbofuchsin.
4. Slide (under microscope) showing the bacilli in a giant cell.
5. Drawing of tubercle bacilli.
6. Sputum of a tuberculous patient.
7. Tubercles in the lung.
8. Miliary tubercles in the lung, spleen, kidney, and liver.
9. Tuberculosis of the liver of a turkey.
10. Miliary tuberculosis of the serous coat of intestine, with ulcers in the mucous membrane and muscular coat.
11. General tuberculosis of the dog.
12. Pearl disease, from a cow.

The original article of Koch in which he so accurately and scientifically described the **tubercle bacillus**, is to be found in the *Berliner klinische Wochenschrift* of April 10, 1882. In this article he announced his now celebrated postulates, viz., that there is found a specific bacillus in tuberculous material which possesses characteristic morphological properties, is capable of taking stains in a peculiar manner, can be cultivated artificially, and when inoculated into certain animals is capable of producing a similar disease to that from which it has been taken, and that the organism is again to be found in the new growths so produced. The bacillus is a rod-shaped, non-motile bacillus, usually slightly bent upon itself at a point beyond the centre, and may contain in the central portion certain ovoidal spots which do not take the stain readily; these have been supposed, but probably wrongly, to be spores. It

is $1\frac{1}{2}$ to 5 microns[1] in length; 0.2 of a micron in breadth. The easiest way to remember its length is in connection with the diameter of the red blood-corpuscle. It is $\frac{1}{4}$ to $\frac{1}{2}$ the diameter of the red blood-cell, which in turn is 7 to 8 microns in diameter. (See Fig. 29.)

There is no disease of greater import to the human race than the one caused by the tubercle bacillus. It is a common statement, and one that is well borne out by the facts, that one-seventh of all

FIG. 29.



Action of tubercle bacilli on a tissue. (ZIEGLER.)

a, epithelioidal cell. *b*, a bloodvessel showing karyokinesis of an endothelial cell (*d*), and outwandering of leucocyte (*e*). *c* and *f* show karyokinetic changes in the tissue itself. *g* is a tubercle bacillus. No giant cells are to be seen as yet.

the deaths in this portion of the country can be directly attributed to tuberculosis in some form or other. Take for example the weekly report of interments for Philadelphia, issued by the Board of Health, and see for yourself if it is not so. It is a disease of all conditions and ages. Tuberculous lesions are found in about 70 per cent. of all adult post-mortems where death is not due to acute diseases and injuries. This would show that nearly everyone living to be forty or fifty years of age, will have had an attack of tuberculosis at some time or other in their life, and that this disease is frequently self-limited.

Domestic animals and wild animals in confinement are frequently affected; the goat is less so than any other animal. The dog is not especially liable to become affected, though it may become tubercular—for example, by licking up the sputum from

[1] A micron is the 1/1000th part of a millimetre, and is represented by means of the Greek letter mu (μ).

a tuberculous master. The lesions here are more like that seen in acute sarcomatosis or carcinomatosis.

In the lower animals the tendency to fibrous formation and calcification is extremely well marked. In cattle it is known as pearl disease; the serous membrane, lymphatic glands, lungs, and liver are specially affected; the mesentery is frequently thickened and retracted and filled with rounded masses, translucent, slightly grayish, and frequently resembling pearls, both as to color and shape. These masses are held together by strong bands of connective tissue interlacing the nodules.

There seems to be a direct relation in regard to the number of cases of tuberculosis to the distribution of the cow, and of the cow to the grass which is necessary for its nutriment. The normal temperature of the cow is 38.5° C., or about one degree higher than that of the human body. This seems to afford the most favorable temperature for the growth of the tubercle bacillus. The great milkers such as the Jersey and Guernsey cows are especially apt to be tuberculous, the lymph glands being specially affected.

Some interesting experiments have been performed by Pearson and others in regard to the use of tuberculin as a diagnostic agent. One of the Trustees of the University discovered by means of the physical signs, which are very difficult of demonstration on the cow, that some of his fine herd of Jersey cattle were tuberculous. Some of the animals were found to be in a condition of advanced tuberculosis, and others were suspected of being so. Tuberculin was injected, and in all those cases where rise of temperature followed, tubercular lesions were discovered at the post-mortem. The use of mallein for the diagnosis of glanders in the horse may be mentioned in this connection; a similar rise in temperature follows. The process is rendered, however, much more acute after the injection of these diagnostic remedies.

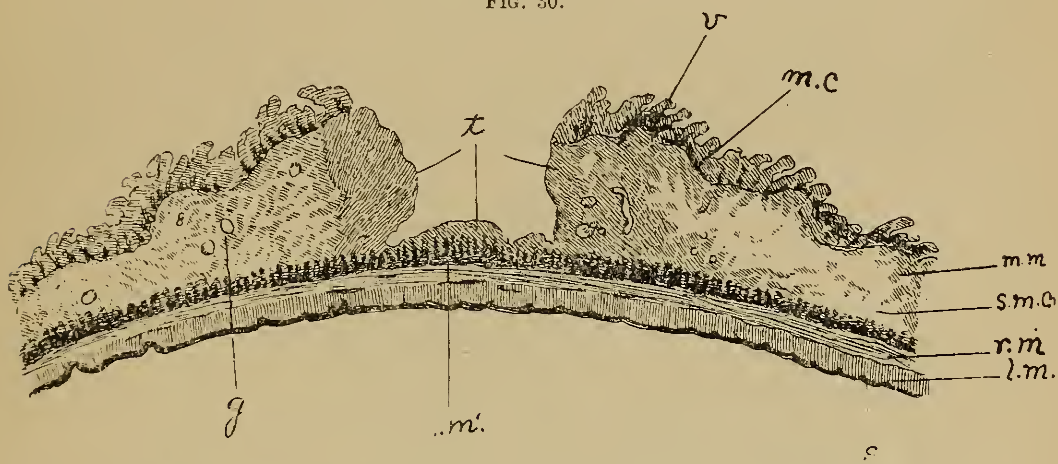
Tubercle bacilli may be found in milk and in urine. The best method of collecting them in these media is by means of the centrifugal machine used to collect the sediment in urine. If this machine is not at hand a conical glass can be employed. They are then stained in the usual manner. It is much easier to make an emulsion out of a tissue with some clear water and a mortar and pestle than it is to attempt to stain the tubercle bacilli in the tissue itself. An ordinary microscope having an amplification of 300 to 350 diameters is all that is necessary for the diagnosing of tubercle bacilli when properly stained.

The bacilli may gain access to the body in various ways:

1. By inhalation—the most common form. When you have finished examining your sputum for tubercle bacilli always thoroughly disinfect the dish and destroy the sputum. For this purpose pure commercial nitric acid gives the best satisfaction. Cornet has shown that the dust taken from a place inhabited by tuberculous patients is capable of causing tuberculosis—*i. e.*, it is infective.

2. By food. It is for this reason that tuberculosis of the alimentary tract is the most common form in children, as they are so frequently fed on cow's milk. It requires thorough cooking to destroy the tubercle bacilli, notwithstanding the fact that they are so difficult to cultivate.

FIG. 30.



Longitudinal section of a tubercular ulcer of the ileum. × 30. (WOODHEAD.)

m. c. Mucosa, which has given way in several spots.
v. Villi, infiltrated and enlarged.
m. m. Slightly altered muscularis mucosæ.
s. m. c. Submucosa, showing a dilatation of the bloodvessels (*g*) and tubercular follicles (*t*).
r. m. Circular muscular fibres, swollen, enlarged, and degenerating at *r. m.'*
l. m. Longitudinal muscular fibres.
s. Thickened and vascular serous coat, showing miliary tubercles following the course of the lymphatics.

3. By inoculation. In the Jewish ritual of circumcision the wound in the child has become infected by the rabbi having a tubercular lesion in the mouth. Persons who make many post-mortems may inoculate their hands, giving rise to what is known as the anatomical wart, which runs a chronic course and discharges at irregular intervals a small amount of acrid pus. It is surrounded with a firm connective-tissue wall, and the feeling is as if a splinter was in the hand, the core extending down deeply into the tissue. The treatment should consist in removal by the

knife or burning out with acid or bromine. As long as the general health is good there is practically no danger of a general involvement. Tubercle bacilli are present, but in small numbers.

Tuberculosis frequently spreads by auto-inoculation, as is seen in the patient swallowing contaminated sputum and the production of ulcers in the intestinal tract. These ulcers are most apt to be found in the ileum near the ileo-cæcal valve, and in the rectum, for the reason that stasis of the contents of the alimentary tract occurs here and a favorable opportunity is given for the growth of the tubercle bacilli. (See Fig. 30.)

4. By heredity. Children have been born with the tubercle bacilli inside of them.

Syphilis.

Cause: micro-organismal.

1. *a.* Congenital. *b.* Acquired.
2. *a.* The initial lesion or chancre. Ex.: Penis, mouth, anus.
   b. Condyloma latum, or mucous patch. Ex.: Anus, mouth.
   c. Gumma. Ex.: Placenta, liver, brain.
3. *a.* Skin diseases. Ex.: Pemphigus.
   b. Syphilitic scars. Ex.: Liver.
   c. Osteo-chondritis. Ex.: Femur.
   d. Ulcers of the larynx.
   e. Rules governing transmission of the disease from parents to child, and child to mother.

Exhibits.

1. Drawings and models showing the initial lesion, or chancre.
2. Specimens showing the mucous patch.
3. Specimens showing gumma.
4. Bone of a child showing osteo-chondritis due to hereditary syphilis.
5. Syphilitic ulceration of the larynx.
6. Syphilitic periostitis.
7. Drawing of Hutchinson's teeth.
8. Drawing of syphilitic keratitis.

Fresh specimens.

There is no doubt that **syphilis** is due to a specific micro-organism, though its nature is not yet known. Several have been described, the bacillus discovered by Lustgarten being the earliest. This bacillus is very similar to the bacillus of tuberculosis, and is considered identical by some observers. The great difficulty of really determining whether or not the syphilitic organism is discovered, is due to the fact that none of the lower animals can be inoculated with the disease. There have been, however, persons willing to subject themselves to inoculation. Robert Cory, an English physician, in order to show the danger of taking even the clear lymph of vaccine for purposes of future vaccination from a syphilitic child, contracted the disease from inoculating himself with such lymph.

While the actual number of deaths from syphilis is not so great as in tuberculosis, the misery and suffering induced by this disease is probably greater than by any other. Dr. Osler is very fond of advising every student practising medicine to be always on the lookout for the lesions caused by the three ancient divinities: Mars, the god of War; Bacchus, the god of Wine; and Venus, the goddess of Love.

It is only necessary to call your attention to some of the various branches of medicine and to name a few examples, in order that you may be at once struck with the great importance of the pathological lesions produced by this disease:

In Surgery: bone and joint diseases.
In Medicine: endarteritis and aneurisms.
In Neurology: locomotor ataxia and brain tumors.
In Obstetrics: abortion.
In Ophthalmology: keratitis and choroiditis.
In Pædiatrics: hereditary syphilis.
In Otology: some forms of middle-ear disease.
In Dentistry: Hutchinson's teeth.
In Dermatology: pemphigus.

It is also a striking feature of syphilis that certain drugs are able to prevent the retrograde tissue metamorphosis.

There is but little doubt that the virus of syphilis is either becoming attenuated or that the treatment is more vigorously pushed, for the older pathologists described many more syphilitic lesions than one is able to find at the post-mortems nowadays. Even in a place like Blockley, where one would expect to find many bodies containing lesions of this character, but few undoubted specimens are found. Among the inhabitants of certain islands and in certain tribes of Indians the first arrival of syphilis can be traced, and the ravages are something frightful, persons frequently dying in the course of several weeks or months after the initial lesion.

According to Cooper (Quain's *Dictionary of Medicine*) the virus is contained in :

1. The discharge of the initial lesion.
2. The secretions of all the secondary eruptive lesions, especially of the mucous patch.
3. The blood during the continuance of the secondary symptoms.

The lesions of the tertiary and later inherited manifestations are non-communicable.

It is possible for the virus of syphilis to pass through the placenta, which may be considered as a filter, in either direction; and if we call F. father, M. mother, and C. child, the following order in which contamination takes place after or during conception is alone conceivable:

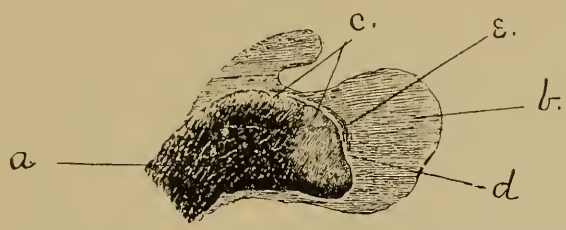
	First.	Second.	Third.	
1.	F.	M.	C.	Usual form.
2.	F.	C.	M.	Rare.
3.	M.	F.	C.	Difficult to conceive of.
4.	M.	C.	F.	M. to C. most usual form.[1]
5.	C.	M.	F.	Difficult to conceive of.
6.	C.	F.	M.	Difficult to conceive of.

It should also be borne in mind that the process may stop at any point—for example, a syphilitic father may affect the mother and the child escape; or the father may give syphilis directly to his offspring, the mother escaping. In the latter case the mother will not contract syphilis by nursing her syphilitic child, whereas a healthy wet-nurse would be extremely liable to contract the disease.

[1] It should always be remembered that the mother may become syphilitic by other than the one by whom she is impregnated, and the child thus contract syphilis.

The good that can sometimes be accomplished by the performance of autopsies is well shown in this connection. Supposing that you are called in to treat a family where repeated abortions

Fig. 31.



Syphilitic osteo-chondritis. (Specimen from a babe dying from inherited syphilis.)

a. Diaphysis. *b.* Epiphysis. *c.* Line of ostitis. *d.* Line of chondritis. *e.* Line of separation of the bone from the cartilage. (Natural size.)

In the long bones, especially the femur, at the junction of the diaphysis with the epiphysis where the bone normally grows, a variety of fatty degeneration from defective nutrition may occur. This can be seen macroscopically as a distinct yellow line between or on the bone and cartilage.

Fig. 32.

Gumma of the liver. (Drawn from a specimen so diagnosed by the late Henry F. Formad, M.D.)

The size may vary from that of a pin-point to a pigeon's egg. The gumma is of a rosy-gray color in the fresh state. The centre exudes a well-formed gummy material, and the edges, made of connective tissue and containing well-formed bloodvessels frequently showing under the microscope a form of endarteritis, merge into the surrounding tissue ; but bands of connective tissue can be seen radiating in various directions into the liver substance itself. A gumma is apt to be found on the upper surface of the liver near the suspensory ligament. A radiating cicatrix dipping down into the liver substance is left on healing. Do not mistake superficial bloodvessels for scars ; these vessels sometimes run for several inches on the surface of the liver and branch a number of times.

have occurred. You make a post-mortem on a fœtus and find a lesion denoting syphilitic osteo-chondritis. (See Fig. 31.) You immediately put the parents on anti-syphilitic treatment, and thus do away with the exciting cause for the abortion.

Hutchinson's teeth, one of the later manifestations of inherited syphilis, consist in a malformation of the teeth, especially showing itself in the upper incisors of the secondary teeth. They are peg-shape, contain a cup-shaped depression on their free margin, often going down into the dentine, and frequently point toward the median line instead of being nearly parallel. A still later manifestation of inherited syphilis is sometimes seen in a thickening and roughening of the periosteum of the superficial bones, such as the tibia.

Scars found at an autopsy on or above the middle third of the anterior part of the leg, and not due to a leg ulcer or accident, frequently point to a syphilitic origin. Remember, also, that the scar of the initial lesion on the genitalia, which, however, presents nothing characteristic of this condition, can frequently be demonstrated in syphilitic cases.

For a description of a gumma, see remarks under Fig. 32.

Glanders.

Etiology: Bacillus mallei (Löffler, Schutz, Israel).

Two forms:

1. Glanders proper (nasal mucous membrane chiefly affected).
2. Farcy (subcutaneous connective tissue chiefly affected).

Found in man and animals (especially in the horse).

Exhibits.

1. Bacilli stained in tissue.
2. Specimen of glanders from the nasal mucous membrane of a horse.
3. Farcy bud.

Glanders is caused by the bacillus mallei, a micro-organism very much like the tubercle bacillus but shorter and plumper. These bacilli frequently join at acute angles, and thus form V-like figures. Portions, said by some to be spores, do not take the stain. They have been found in the blood. Glanders proper is chiefly

confined to the mucous membranes of the nasal cavities of the horse, and man contracts the disease by coming in contact with the exudate. Cases are on record in which the hostler contracted the disease from washing himself with the same sponge which was employed in warm weather for bathing the mouth of the horse.

The bacillus is a pus-producing micro-organism, and a honey-combed appearance is given to the part attacked. The submaxillary gland is frequently affected, and metastasis may then take place to other organs, especially the lungs and alimentary mucous membrane, and farcy buds may be found in the subcutaneous connective tissue and muscles. These nodules follow the lymphatics and give the appearance of a string of beads. In man the disease sometimes simulates typhoid fever. The nodules may run a very chronic course, appearing in successive crops. They very frequently break down in the centre. Glanders and actinomycosis are not so rare as might be supposed, and one should always be on the lookout for these lesions—more especially, however, in those who are thrown in contact with the lower animals.

Actinomycosis.

Found in animals, especially the graminivora, and in man.

Exhibits.

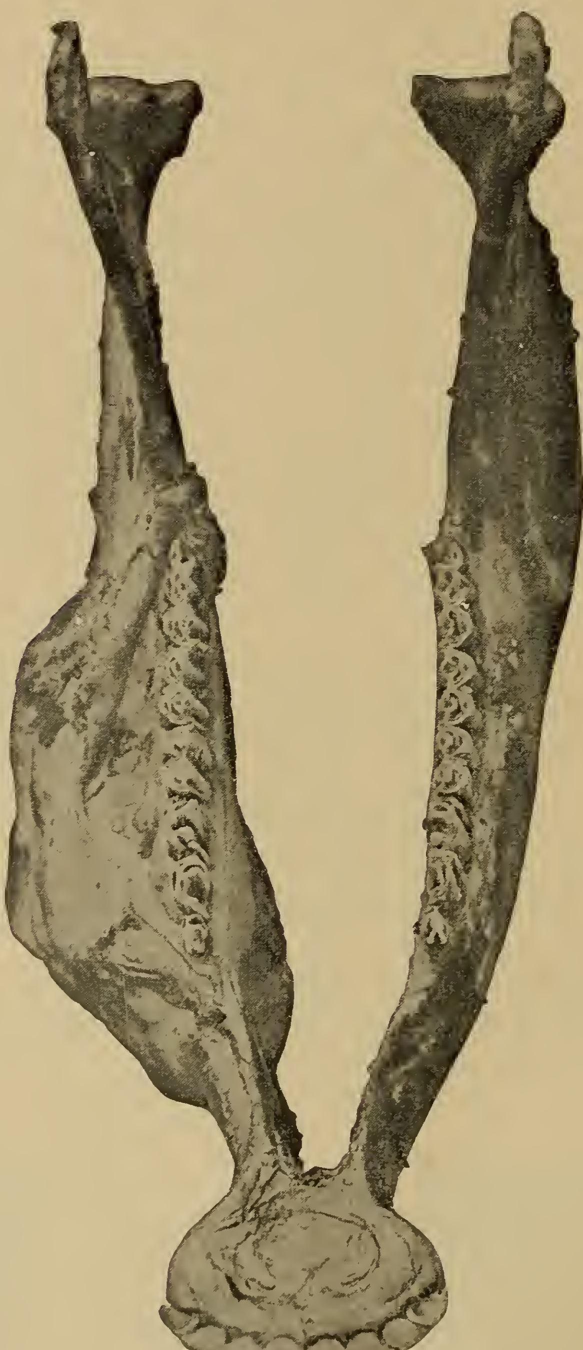
1. Culture of the ray fungus.
2. Slide and drawing of a nodule taken from the tongue of a cow.
3. Specimen of "lumpy jaw" from a cow.
4. Picture of Bodamer's case, from the *Trans. Phila. Path Soc.*, vol. xiv.

FIG. 33.

Drawing of the ray fungus from Bodamer's case.

The question of whether or not the actinomycetes are fungi has been much discussed. Isenberg so classifies them. The disease is

FIG. 34.



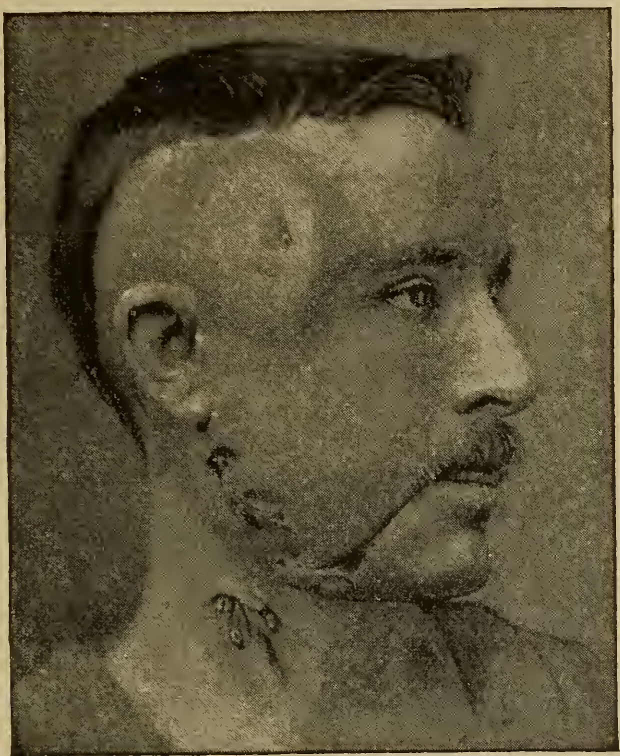
Lower jaw of an ox affected with "swelled head." Photographed from the first specimen described in this country by Bodamer.

found, especially in those animals which eat grain. It is stated by some laboratory workers that the fungus is found attached

to the barley, corn, or rye, and that it is thus introduced into a fissure in the mucous membrane of the animal's mouth. Special modes of staining have been suggested, that by the pure archil (orseille) or orceïn giving the best result by means of a single stain.

Actinomycosis was formerly mistaken for tuberculosis and various bone lesions such as giant-celled sarcomata, osteo-sarcomata, etc. The fungus grows in rosette-shaped masses (see Fig. 33), the

FIG. 35.



Bodamer's case of actinomycosis. The scar tissue is well shown. The ughly scars left in the neck are sometimes due to the ray fungus and not to tuberculosis.

active, living portion being the centre, while the periphery is dead or dying. This is so different from the tubercle, where the opposite condition prevails. A round-cell infiltration takes place around the mass and serpiginous ulcers form, discharging a muco-purulent pus which contains rounded, yellowish, or sulphur-like bodies, varying in size from that of a pin-point to that of a good-sized pea. These bodies, with the honeycombed appearance of the part affected, are diagnostic macroscopically of this disease. These yellowish masses can be hardened and stained. The lower and upper jaws of cattle (see Fig. 34), with the first part of the

alimentary tract, are most frequently affected, while in man the soft tissues of the face and neck, lungs, and mediastinum become diseased. George A. Bodamer, the first in this country to demonstrate this condition among the lower animals, showed a patient (see Fig. 35) of his, suffering from this disease, to the Philadelphia Pathological Society, January 1, 1889. At that time only six cases had been observed in man in this country. Actinomycosis has been observed as occurring primarily in the vermiform appendix. This should be remembered as a rare cause for appendicitis.

Tumors.

A tumor is literally a swelling, but the term is more especially applied to a new growth, which may be either cystic or solid.

Synonyms: Neoplasm, hyperplasia, new growth.

Theories of Tumor Formation.

Tumor diathesis (Billroth).
Embryonal or evolutional (Cohnheim).
Mechanical (Virchow).
Nervous.
Parasitic.

For the sake of an example illustrating the different theories of tumor formation, let us suppose that a woman, aged forty years, living near Buffalo, where cancer is very common, should have inherited a weakened constitution from cancer being present in the family for many generations. A blow having been received upon the breast, some embryonal epithelial tissue was injured, and the skin being abraded, a psorosperm gained access to the part. As the nervous influence controlling the chest was injured or destroyed by the shock of the blow, a cancerous tumor developed in the region of the breast.

Tumors may be described in various ways:

1. According to shape.
2. According to malignancy.
3. According to their embryological prototype.

1. Shape of Tumors.

A. 1. Deep-seated. 2. Superficial.

B. Uniform swelling, flat tabular swelling, tubers, fungoid,

polypoid, papilla, dendritic, mushroom, nodes, sessile, pedunculated, cauliflower, etc.

C. The shape is influenced by: 1. The situation, mechanical pressure, etc. 2. The method of growth of a tumor.

A. Deep-seated:

1. Uniform swelling: *a*, glioma; *b*, goitre; *c*, lymphoma; *d*, lymphangioma; *e*, sarcoma; *f*, rhabdomyoma; *g*, lympho-sarcoma.

2. Nodes growing centrally: *a*, fibroma; *b*, myoma; *c*, myo-fibroma; *d*, myxoma; *e*, adenoma; *f*, osteoma; *g*, chondroma; *h*, secondary cancer and sarcoma.

3. Nodes growing peripherally: *a*, primary sarcoma; *b*, primary carcinoma.

4. Cysts: *a*, retention; *b*, extravasation; *c*, exudation (as ovarian and parovarian); *d*, softening; *e*, parasitic; *f*, dermoid.

B. Tumors on the surface:

1. Flat tabular swelling: *a*, keloid; *b*, angioma; *c*, lymphan-gioma; *d*, squamous epithelioma; *e*, cholesteatoma; *f*, sarcoma of serous membranes.

2. Tubers (a partly projecting node): *a*, osteoma; *b*, chondroma; *c*, osteoid-chondroma; *d*, giant-cell sarcoma.

3. Fungus (fungus hæmatoides): *a*, soft cancer; *b*, telangi-ectatic sarcoma; *c*, cavernous angioma.

4. Polyps: *a*, myxoma; *b*, soft fibroma; *c*, lipoma; *d*, adenoma; *e*, sarcoma of serous sacs.

5. Dentritic: *a*, warts; *b*, papilloma; *c*, epithelioma.

6. Papillæ: *a*, horns; *b*, corns; *c*, condyloma.

2. Malignancy of Tumors.

By malignancy is understood that a tumor is in the possession of one or more of the following properties:

1. Recurrence; after the tumor has been removed it will be found after a certain length of time to again appear.

2. Metastasis; one or more of the constituent elements of the tumor is carried from one part of the body to another, and there gives rise to the same kind of growth as the one from which the tumor sprang.

3. Infiltration and destruction of the surrounding tissue.

MACROSCOPIC TABLE OF DIFFERENCES BETWEEN BENIGN AND MALIGNANT TUMORS.[1]

Benign Tumors	*Malignant Tumors*
1. Are homologous and typical.	1. Are heterologous and atypical.
2. Are rich in fibres and poor in cells. Cells are large.	2. Are poor in fibres and rich in cells. Cells are small.
3. Grow centrally and comparatively slowly.	3. Grow peripherally and comparatively fast.
4. Have a capsule.	4. Are not encapsulated.
5. Are usually poor in bloodvessels, except angioma.	5. Are rich in bloodvessels, except hard cancer.
6. Are usually fair in consistence and dry, except myxoma.	6. Are soft and juicy.
7. Seldom ulcerate, except lipoma.	7. Often ulcerate in tumor itself.
8. May grow large and grow upward.	8. Seldom grow large, except sarcoma springing from bone. Grow principally downward.
9. May be primarily multiple.	9. Never primarily multiple, except melanotic sarcoma.
10. Do not recur after removal.	10. Do recur after removal.
11. Give no metastasis.	11. May give metastasis.
12. No cachexia.	12. Cancer gives a cachexia, especially when metastasis has taken place.
13. May kill mechanically by weight, pressure, hemorrhage, etc.	13. Kill by infiltration and destruction of the surrounding tissues.
14. Prone to calcareous infiltration and fatty degeneration.	14. Prone to colloid and telangiectatic changes.

No age is exempt from tumors; but cancers usually occur after middle life.

The situation of a tumor often gives valuable information as to whether it is benign or malignant.

The situation of a tumor may make a benign tumor malignant, or a malignant tumor harmless if the proper surgical interference be taken.

It is of course understood that the above statements are not to be considered as dogmatic. When taken together, even without a microscopic examination, they furnish strong evidence of whether or not the tumor is benign or malignant.

The chief desire of a patient is to know whether or not a tumor

[1] This table and the one on sarcoma and cancer are based largely upon the work of the late Henry F. Formad.

is malignant, and the intelligent physician will seek to answer this question by every means in his power.

3. Embryological Classification of Tumors.

This is the scientific method of studying tumors, and is the one that is usually adopted for purposes of study.

Tumors may be divided into

A.

*1. Parablastomata or connective-tissue tumors.
2. Archiblastomata or parenchymatous tumors.
3. Teratomata or mixed tumors.

B.

According to Woodhead:

1. Simple or histioid tumors (composed of one kind of tissue).
2. Sarcomatous tumors.
3. Cancerous.

C.

According to Sutton, tumors are conveniently arranged into four main groups, each group containing several genera, each genus having one or more species, and of each species there may be one or more varieties. The groups are:

I. Connective-tissue tumors.
II. Epithelial tumors.
III. Dermoids.
IV. Cysts.

I. CONNECTIVE-TISSUE TUMORS.

Genera.	*Species.*
1. Lipomata (fatty tumors).	1. Subcutaneous. 2. Subserous. 3. Subsynovial. 4. Submucous. 5. Inter-muscular. 6. Intra-muscular. 7. Periosteal. 8. Meningeal.
2. Chondromata (cartilage tumors).	1. Chondromata. 2. Ecchondroses. 3. Loose cartilages in joints.
3. Osteomata (osseous tumors).	1. The compact or ivory osteoma. 2. The cancellous osteoma.

Genera.	*Species.*
4. Odontomata (tooth tumors).	1. Epithelial odontome, from the enamel organ. 2. Follicular odontome; 3. Fibrous odontome; 4. Cementome; 5. Compound follicular odontome: 2, 3, 4 and 5 are from the tooth follicle. 6. Radicular odontome: from the papilla. 7. Composite odontome: from the whole germ.
5. Fibromata (fibrous tumors).	1. Simple fibromata. 2. Molluscum fibrosum (include here keloid). 3. Neuro-fibromata.
6. Myxomata.	1. Nasal and aural polypi. 2. Cutaneous myxomata. 3. Neuro-myxomata.
7. Gliomata (neuroglia tumors).	Found in brain, cord and retina.
8. Sarcomata.	1. Round-celled sarcoma (small and large). 2. Lympho-sarcoma. 3. Spindle-celled sarcoma (small and large). 4. Myeloid or giant-celled. 5. Alveolar. 6. Melanotic. The relative malignancy of the sarcomata being as follows: 1st. Lympho-sarcoma, small round-celled sarcomata, melanotic, spindle-celled myo-sarcoma, spindle-celled chondro-sarcoma, myeloid sarcoma.
9. Myomata (muscle tumors).	1. Leiomyomata (rhabdo-myomata, considered by Sutton as a variety of the spindle-celled sarcoma). Met with in the uterus, broad ligament, ovary, ovarian ligament, round ligament of the uterus, vagina, œsophagus, stomach, intestine, scrotum, skin, bladder, and prostate.
10. Neuromata (tumors on nerves).	1. Neuro-fibromata. 2. Plexiform neuromata. 3. Traumatic neuroma.
11. Angiomata (tumors composed of bloodvessels).	1. Simple nævus. 2. Cavernous nævus. 3. Plexiform angioma.
12. Lymphangiomata (tumors of lymphatic vessels).	1. Lymphatic nævus. 2. Cavernous lymphangioma. 3. Lymphatic cyst.

II. EPITHELIAL TUMORS.

Genera.	*Species.*	
1. Papillomata	Skin Warts.	
	Villous papillomata.	
	Intra-cystic warts.	
	Psammomata.	
2. Cutaneous horns	Sebaceous horns.	
	Wart horns.	
	Cicatricial horns.	
	Nail horns.	
3. Epithelioma	Epithelioma.	
4. Adenoma	Mammary.	Renal.
	Sebaceous.	Ovarian.
	Thyroid.	Testicular.
	Pituitary.	Gastric.
	Prostatic.	Intestinal.
	Parotid.	Fallopian.
	Hepatic.	Uterine.
5. Carcinoma (cancer)	Mammary.	Renal.
	Sebaceous.	Ovarian.
	Thyroid.	Testicular.
	Prostatic.	Gastric.
	Parotid.	Intestinal.
	Pancreatic.	Fallopian.
	Hepatic.	Uterine.

III. DERMOIDS.

Genera.

1. Sequestration dermoids.
2. Tubulo-dermoids.
3. Ovarian dermoids.
4. Dermoid patches.

IV. CYSTS.

Genera.	*Species.*
1. Retention cysts	Hydrometra.
	Hydrosalpinx.
	Hydronephrosis.
	Hydrocholecyst.
2. Tubulo-cysts	Vitello-intestinal.
	Allantoic (urachal).
	Paroöphoritic.
	Parovarian.
	Cysts of Gartner's duct.
	Cystic disease of testis.
	Encysted hydrocele of testis.
	Cysts of Müller's duct.

Genera.	*Species.*
3. Hydroceles	Of the tunica vaginalis. Of the canal of Nuck. Of the ovary. Of the neck.
4. Gland cysts	Ranulæ. Pancreatic cysts. Chyle-cysts. Dacryops.

There are conditions often classed as cysts which are arranged in a sub-group entitled PSEUDO-CYSTS:

1. Diverticula	Intestinal; vesical; pharyngeal; œsophageal; tracheal; synovial; meningeal.
2. Bursæ	Bursa.
3. Neural cysts	Hydrocephalus; hydrocele of fourth ventricle; meningocele (cranial); spina bifida.
4. Parasites	Hydatids.

Lipomata.[1]

Exhibits.

1. Lipoma of the intestine.
2. Lipoma of the thigh, in which calcareous infiltration has taken place.
3. Slide of a lipoma.
4. Slide of a lipo-sarcoma[2] of the adrenal.

Fresh specimens.

Lipomata most frequently grow in those situations where normally there is fat, exceptions being found, as in the brain and the submucous tissue of the intestine. They may be single or

[1] The student must not get confused with the word lipæmia—fat in the blood.

[2] It may be well to mention here that the tumor which predominates has the last place in a compound-word describing a tumor made up of more than one tissue.

seen in combination with osteoma. This class of tumor frequently favors the embryonic theory, as Virchow has shown that islands of cartilage are often to be found in the bones, especially of rickety children. They are especially seen springing from the periosteum of bones, those of the metacarpal bones being a favorite seat (see Plate III., showing Whittaker's case of multiple osteo-ecchondromata). They are found in the testicle, skin, lung, breast, etc. In the testicle and the parotid gland they are sometimes seen as a congenital tumor, and are here frequently in combination with other tumors as osteoma and sarcoma (myxochondro-adenoma).

Macroscopically they are firm elastic tumors, cutting with the peculiar creak of cartilage, and in color resemble the boiled white of an egg or the inside of an oyster-shell. If mucoid degeneration has taken place they may be soft and gelatinous. They are encapsulated and appear as rounded or lobulated masses, separated by fibrous tissue containing the bloodvessels.

Microscopically, the appearance of the field is that of cartilage, though the cells present more irregularity: in shape, in being found with and without capsular walls, and in their arrangement. All kinds of cartilage from the white fibrous to the hyaline forms are found (Woodhead). True bone formation may occur or calcareous infiltration alone may take place.

Osteomata.

Exhibits.

1. Osteo-sarcoma.
2. Odontoma.

The chief seat for bony tumors is between the bone and its cartilage, and they are really ossifying chondromata. An exostosis should not truly be classed as a tumor. There are three kinds: eburnated (like ivory), compact, and spongy.

In the eburnated variety the growths may be single or multiple. The lamellæ follow the outline of the tumor and contain no bloodvessels or Haversian canals, though canaliculi are found.

The compact osteoma may be found in the meninges of the brain, choroid of the eye, in the pericardium, etc. The vessels and Haversian canals run at right angles to the long axis of the bone.

In the spongy form Haversian systems are seen, and the character of the growth is like that seen on the extremities of the long bones.

FIG. 1.—Anterior view of case of multiple osteo-ecchondroma.

FIG. 2.—Posterior view of the same case.

The odontomata (see page 72) may be classified here. They are no doubt often mistaken for osteomata.

Fibromata.

Exhibits.

1. Inter-, intra-, and extra-mural uterine fibromata.
2. Calcareous, myxomatous myo-fibroma of the uterus.
3. Pendulous fibroma of the vulva.
4. Keloid.
5. Slides showing fibromata: *a,* hard; *b,* soft; *c,* undergoing calcification.

Fibromata are slow-growing, non-malignant tumors composed of fibrous tissue and usually originating in those situations where normally fibrous tissue is to be found. The younger the form of connective tissue the more apt are they to return if improperly removed. Fibromata do not give metastasis, though they are frequently found multiple upon the skin as in the fibroma molluscum. Yellow elastic tissue does not form a tumor; it is the white fibrous tissue from which the tumor originates and of which it is composed. If they grow from the mucous membrane they frequently become œdematous, and it is sometimes difficult or impossible to state whether a fibroma of the nose has undergone myxomatous change or whether it is a mucoid polyp.

There are two kinds, fasciculated and lamellar or flat fibroma. Macroscopically the fasciculated, which is the one commonly met with, is seen as a firm, dry, glistening, whitish or grayish tumor, spots of myxomatous softening with hemorrhages frequently being discovered upon the cut surface. It is rounded, usually lobulated, and has a capsule. Each lobule is composed of concentric layers of fibrous tissue. They seem to grow from their centre and show a looser form of connective tissue in which are to be found the blood-vessels.

Two kinds are described according to the sense of touch, namely, that of soft or hard. Under the microscope this distinction is discovered to depend upon whether there are many cells or much development of fibrous bands. Picric acid stains fibrous tissue a characteristic pink color, and is therefore used in diagnosing this tissue from the myoma. (It is very difficult to distinguish under the microscope a myoma, a slowly growing spindle-celled sarcoma,

and a pure fibroma.) These tumors reach an enormous size, are apt to become cystic, or fatty degeneration, hemorrhages, and calcification may occur.

The flat fibroma is frequently merely an overgrowth of the connective tissue enclosing an organ, as in the spleen or pleura; they are usually yellow, translucent, and cut with great difficulty. Keloids occur especially as an overgrowth of scar tissue in the colored race.

Myxomata.

Exhibits.

1. Nasal and aural polyps.
2. Slide showing the branching and interlacing cells.
3. Myxomatous polypi from the mesentery of a hog.

The tissue here is the same as that seen surrounding the vessels in the umbilical cord. The sessile myxoma is sometimes in combination with a sarcoma, and, therefore, recurrence may be found (sarcoma myxomatodes). For an illustration of a nasal polyp, see Fig. 21, page 36.

Gliomata.

Fresh specimens.

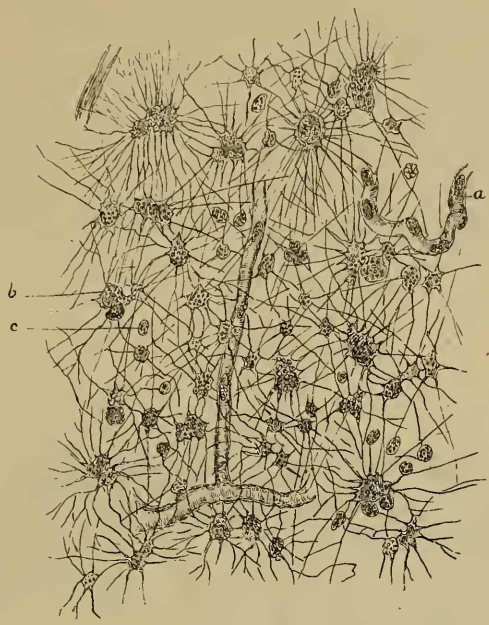
Exhibits.

1. Glioma of the cerebellum.
2. Slide from a glioma.

A great deal of confusion is occasioned in the use of the word glioma, some holding it to be merely a variety of sarcoma. This occurs from the fact that histologists are not certain as to the origin of the neuroglia of the nervous system. It is usually found in early life, and there is a gradual replacement of the nervous tissue by means of the neoplasm, the difference in color and consistence often being but slight; the tumor is, however, usually slightly darker and harder than the brain or cord, the color depending largely on its vascularity. The tumor is made up of neuroglia cells, the intra-nuclear plexus of the nucleus and

the branching processes being easily observed under the microscope. Bloodvessels, often numerous, are to be seen running in and out

FIG. 36.



Gliomatous tumor of the brain from a boy. × 175. (HAMILTON.)
a. Bloodvessel. *b.* Spider cell with double nucleus. *c.* Small round cell.

among these cells (see Fig. 36). In an autopsy at Elwyn, the writer found some forty or fifty of these gliomatous masses scattered throughout the brain of an idiot.

Sarcomata.

Exhibits.

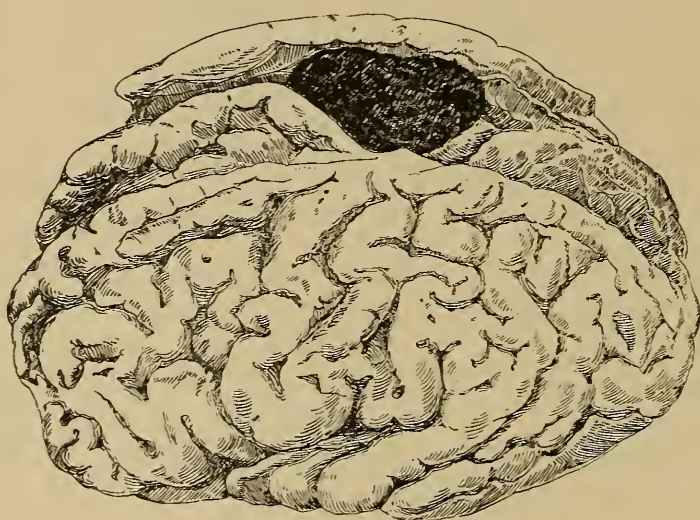
1. Recurrent large round-cell sarcoma of the elbow.
2. Myeloid sarcoma of the knee.
3. Sarcoma of the shoulder.
4. Recurrent melanotic sarcoma of the stump.
5. Melanotic sarcoma of the heart; metastasis from the lungs.
6. Spindle-cell sarcoma of the eye.
7. Various microscopic slides from the above.

A sarcoma is composed of embryonic connective tissue, and is, therefore, made up of mesoblastic (parablastic) tissue in an imperfect state of development. An abortive attempt is frequently made to reproduce other varieties of connective-tissue cells, such as

those of fibrous tissue, bone, cartilage, etc. For the varieties see page 72.

Remember that it is often impossible to tell ordinary granulation tissue from a sarcoma. If there be no landmarks by means of which you can tell, the pathologist should always demand the exact situation from which the tumor was removed, age of the patient, sex, etc., before making a diagnosis. A case in point well illustrates the danger of not knowing all about a tumor before making a diagnosis. A prominent pathologist was once sent a portion of tissue from the neighborhood of the buttock and was told that it was a portion of a tumor. The diagnosis of sarcoma was made, the limb was

FIG. 37.



Sarcoma of the dura.

(From a patient of Dr. Sinkler in the Philadelphia Hospital. Post-mortem by the author. *International Medical Magazine*, November, 1892.)

amputated, and the patient lost his life. At the post-mortem it was found that the tumor was composed of lipomatous tissue, and that the piece sent for diagnosis had been removed from an ulcerating surface, which would, of course, show granulation tissue.

Physicians often expect more from the pathologist than they should, even going so far as to refuse to tell from what part of the body the tumor comes, or of telling the age, etc. Under such circumstances the pathologist should absolutely refuse to give an opinion, for at the best the physician has the more favorable opportunity of casting the blame upon the pathologist, as later developments will often prove the correctness or incorrectness of a pathological diagnosis when the specimen is in your hand. Per

FIG. 38.

Myeloid or giant-cell sarcoma. × 300. (WOODHEAD.)

a. Spindle cells of which the tumor is principally composed. *b.* Cells arranged to form the walls of embryonic bloodvessels. *c.* Giant cell, with large number of nuclei scattered throughout its protoplasm. *d.* Transverse section of spindle cells appearing as round cells. *e.* Extravasated red blood-corpuscles.

FIG. 39.

Sarcoma of the shoulder, springing in part from the scapula, but originating in the skin over the clavicle. The thickening of the skin of the arm was congenital. Metastasis to lungs. Point at top of tumor shows ulceration. From the shape the tumor might easily be a lipoma. (Specimen No. 92 of New York Hospital. Drawing from a cast in the Wistar Museum, University of Pennsylvania.)

contra, at a post-mortem, unless gross carelessness is discovered, the pathologist should never blame the clinician for mistakes in diagnosis.

FIG. 40.

Dr. C. A. Oliver's case of spindle-cell sarcoma of the choroid, showing a mushroom-like tumor. (From a photograph by the author. *University Medical Magazine*, December, 1893.)

TABLE OF DIFFERENCES BETWEEN SARCOMATA AND CARCINOMATA.

Sarcomata.	*Carcinomata.*
1. Are of a connective-tissue type and are composed nearly entirely of cells embodied in a homogeneous or reticular matter. Rarely forms alveoli.	1. Are of both a connective-tissue and epithelial type, and are composed of cells lying free in the alveolar spaces formed by pre-existing connective tissue.
2. Cells endothelial, embryonal, or lymphoid.	2. Cells exclusively epithelial. Distinct nuclei and nucleoli.
3. Acetic acid and caustic potash almost dissolve them.	3. Acetic acid and caustic potash have no effect.
4. Have bloodvessels without muscular walls, and running free between the cells. Small hemorrhages common.	4. True bloodvessels and also nerves running only through the connective-tissue framework.
5. No fat within tumor proper.	5. Fat may be seen within the cancer tissue. Rarely encapsulated.
6. Metastasis by the bloodvessels.	6. Metastasis by the lymphatics, though in later stages may spread with great rapidity by the bloodvessels.
7. May affect lymph glands primarily, but not by metastasis.	7. Do not develop in lymph glands primarily, but often affect them by metastasis.
8. Develop in connective-tissue substance. Deep-seated and grow upward.	8. Develop from epithelium. Usually peripheral and grow downward.
9. Skin not adherent.	9. Skin frequently adherent.

Sarcomata.	*Carcinomata.*
10. Not usually painful.	10. Painful.
11. Grow in young well-nourished individuals chiefly.	11. Grow chiefly after middle life.
12. Not hereditary.	12. Often hereditary.
13. Grow rapidly.	13. Grow slowly.
14. No micro-organism yet described.	14. Due (?) to the psorosperm.
15. Juice absent or seen some hours after removal.	15. Juice can be expelled.
16. Flesh-like, rounded, and regular masses. On section, smooth pearly surface, often of a reddish tinge.	16. Nodular and irregular, often ulcerating surface. On section, more granules are opaque, less reddish.
17. Infiltration of surrounding tissue when present is best seen with the microscope.	17. The malignancy of cancer is greater than that of sarcoma, the growth infiltrating into the surrounding tissue.

The illustrations (Figs. 37, 38, 39, and 40) show a few of the many varieties and shapes seen in sarcomata.

Myomata.

Fresh specimens.

Exhibits.

1. Myoma of the uterus.
2. Rhabdo-myoma of the kidney.

A myoma is made up of muscular tissue, and, as this is of two kinds, we have the leio-myoma and rhabdo-myoma, the latter being usually a congenital tumor and rather belonging to the higher development of a tissue of the sarcomatous type. A myoma of the uterus is frequently spoken of as a uterine fibroid, and may be intra-mural, submucous, or subserous. In the intestinal tract, and often elsewhere, it is usually pedunculated. A 40 per cent. solution of caustic potash may be employed for differentiating the non-striped muscular tissue from fibrous tissue. When a portion of the tumor is placed in this solution for a space of time varying from twenty minutes to an hour, the fibrous tissue disappears after swelling up, the rod-shaped nuclei of the muscle cells appearing in a striking manner. They may undergo mucoid degeneration, fatty metamorphosis, calcification, septic infection, etc.

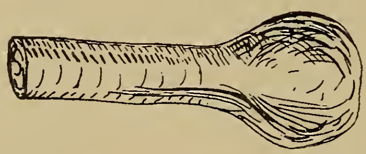
Neuromata.

Exhibit.

1. Neuroma of a large nerve in a stump.

This tumor is usually an overgrowth of the connective tissue of the nerve, though it may be composed of nerve fibrils or ganglion cells, as in the adrenal. (See Fig. 41.)

FIG. 41.



False neuroma of the stump of the arm. Case of Dr. W. G. Porter in the Presbyterian Hospital. (Natural size.)

Angiomata.

Exhibits.

1. Cavernous angioma of the liver.
2. Nævus.

Angiomata are of two kinds: telangiectatic and cavernous. In the first variety there is merely an overgrowth of the normal capil-

FIG. 42.

Section of a simple hypertrophic angioma of the skin, the duct of a sweat gland being shown in the centre of the drawing. × 200. (ZIEGLER.)

laries. These may be observed almost any day upon the street as large, slightly elevated, purplish-red patches upon the face (see

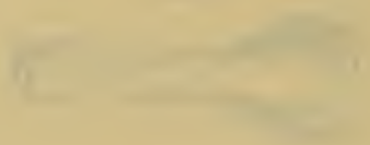


Fig. 42). In early life they may be frequently seen as spiderweb-shaped masses, which, later on, for some reason or other, spread into the surrounding tissue.

The writer remembers seeing the following case in Osler's clinic at the Orthopædic Hospital. A young mother, about three months pregnant, came into a room where a child was sleeping in a cradle which was on fire. In rescuing the child she severely burned her wrist. She was very much impressed with the danger through which she had passed as well as with the burns, and in conversation she frequently remarked to her friends that she was afraid her own child would be in some way affected, and she seemed to worry about this considerably. She was delivered of her child at full term and there was noticed on the child's arm a nævus situated on the flexor surface above the wrist corresponding exactly both as to the position and shape of the scar on the mother's arm. How the maternal impression could produce, if it really did produce, this effect is not known, but many cases similar to the above are recorded in medical literature.

In the cavernous angioma you have channels lined with endothelial cells such as are seen in the membranous portion of the penis. They are found especially upon the free surface of the liver in old people, and give rise to no clinical symptoms during life.

Lymphangiomata.

Here, instead of having the blood capillaries involved, as in angiomata, we have the lymphatics. In case the lymphatics of the tongue are affected the condition is known as that of macroglossia; if the cheek, macrocheilia.

Epithelial Tumors.

Exhibits.

1. Hard cancer of the breast.
2. Colloid cancer of the stomach.
3. Paget's disease of the nipple.
4. Primary cancer of the œsophagus with metastasis to the liver.
5. Primary cancer of the gall-bladder.
6. Squamous epithelioma of the penis.

The epithelioma is especially apt to occur in those situations where the skin and mucous membrane come in contact the one with the other, such as at the lips or anus. Epithelioma of the œsophagus is four times more frequent in males than in females.

Adenoma.

The adenoma may be defined as a tumor constructed upon the type of, and growing in connection with, a secreting gland, but differs from it in being impotent to produce the secretion peculiar to the gland it mimics.

Carcinomata.

Carcinomata are tumors that always grow from pre-existing gland-tissue and mimic the parent gland, but they differ from adenomata in the fact that the structural mimicry is incomplete; the epithelial cells, instead of exhibiting the regular disposition so constant in those tumors, are in the cancers collected in the acini

FIG. 43.

Development of a cancer of the breast. × 300. (HAMILTON.)
Acini which may be regarded as normal are often lined with a double row of polyhedral or rounded epithelial cells.

and ducts in irregular clusters or fill them so completely as to give rise to the appearance of sections of columns of epithelial cells when seen under the microscope (Sutton). The varieties of car-

cinoma are squamous, cylindrical, and glandular. Figures 43, 44, and 45, from Hamilton's *Pathology*, show very well the normal acini of the breast, then the adenomatous stage, and finally the production of a cancer, thus giving the easiest explanation of the formation of a cancer.

Paget's Disease.

Paget's disease is considered by some authorities as simply an eczema of the breast with a retracted nipple; by others as an early lesion of cancer. The experiments performed by Power,

FIG. 44.

Lobule of the gland in which the acini are in the adenomatous stage. × 50. (HAMILTON.)

Some normal acini are seen, but most of the acini are distended with epithelial cells. The stroma is seen surrounding the acini and is not yet invaded by the cells.

of injecting the fresh material of a Paget's breast into the previously irritated vagina of a white rat, would seem to show that the condition can be communicated from one animal to another, and that it is similar to the growth from the coccidia.

Encephaloid Cancer.

An encephaloid cancer is the synonym for a soft or medullary cancer; the scirrhus cancer is equivalent to a hard cancer.

It was formerly thought that the cancerous cells were peculiar. These cannot be told from other epithelial cells which are to be found normally in the body.

FIG. 45.

The acini in the upper portion of the figure are still adenomatous, while those in the lower part have become cancerous. × 350. (HAMILTON.)

The stroma having given way, the cells are now escaping into the surrounding tissue and forming nests.

Cuirass Cancer.

Cuirass cancer is an induration of the skin after the removal of the tumor growth, in which the resemblance to a shield is marked.

Lymphatic Œdema.

Lymphatic œdema is a condition in which the circulation of a part or limb is so interfered with that the return of the blood by the veins is difficultly accomplished.

The verdict of "not proven" must be given in regard to whether or not cancer is due to one of the lower forms of life.

PART II.

POST-MORTEMS.

As the usual object of an autopsy is to find out the cause of death, either for legal or scientific purposes, all post-mortems should be conducted in as thorough and accurate a manner as possible. For this reason it is well to have a routine method of examining the body, which is only to be departed from in exceptional instances, and to dictate all notes while the autopsy is in progress. Drawings, photographs, casts, cultures of micro-organisms and microscopic slides are valuable additions to a well-written account of an autopsy. One post-mortem thoroughly worked up is of more value than one hundred incomplete ones.

In writing the account of an autopsy describe what you see; do not use names of diseased conditions. These should be put in under the head of pathological diagnosis. One should first of all learn the normal appearances of the organs in order that the abnormal may not be mistaken for the normal. A lesion found in one portion of the body will often suggest a careful search for a lesion in another part of the body, even though far distant; for example, a multiple melanotic sarcoma of the liver would cause you to examine the eye for the primary lesion. Do not jump at conclusions too quickly. Tentative diagnoses alone should be made until the post-mortem is completed. And even after a most careful post-mortem, it is at times impossible to tell from what the patient died.

Get all the anatomical knowledge you can out of every autopsy you make. It is, therefore, usually advisable, especially in the case of females, to perform a preliminary laparotomy. Many surgical operations can be practised upon the body without disfigurement, such as Alexander's operation, oöphorectomy, removal

of the ear ossicles and vermiform appendix, stretching of the sciatic nerve, symphysiotomy, etc.

You should be sure that you have a legal right to make the post-mortem before you begin. The nearest relative, or the one who is going to pay the expenses of the funeral, should give the consent in writing. If there be the slightest suspicion of foul-play make the case a Coroner's one. The feelings of the friends should be respected in every possible manner, and one should remember that scientific and pathological zeal is no excuse for doing anything that may in any way shock the feelings of those who are brought in contact with the dead. One poorly conducted autopsy in your neighborhood may prevent you from obtaining a dozen others. The laity should be encouraged to ask for the making of autopsies, so that a natural desire may exist among the public; in seeking to foster this spirit you can well see that incalculable damage may be done in a community by a single ill-conducted autopsy. Tact will get you many autopsies. Curiosity of relatives and friends can often be worked upon to get permission for an autopsy. Those holding insurance papers will often find a blank asking whether or not a post-mortem examination has been made. A much stronger case is certainly made out when a post-mortem examination has been conducted by the attending physician.

Invite your friends to the autopsy. The recent graduate is one who is usually picked out to start the autopsy. Be prepared for all sorts of suggestions (many of them absurd) from those who are attending the autopsy, though two heads are often better than one. *Per contra*, if you are not making the autopsy yourself, do not be too forward in making suggestions to the one who is making it; but always be ready to do anything that you are asked to do in connection with the autopsy.

Any organ which you desire to save should be placed in a safe place, so that it will not be returned to the body and sewed up. It is not wise to take away more tissue from a post-mortem than you are thoroughly able to work up. Permission should be asked for any specimen which you may take away, but it is not necessary to ask the nearest relative, as in getting permission for the autopsy, or to tell the actual amount of material you are going to remove.

Label all your specimens at once with the name of the person from whom the specimen is removed, character of the specimen and relations in the body, date, and preservative fluid employed.

Some Legal Considerations.

If you discover suspicious lesions while making an autopsy, always stop the post-mortem and report the case at once to the Coroner.

In legal cases be sure to protect yourself in every possible way. The jars (which should never have been used) containing the specimens should be sealed in the presence of a witness. In important cases here in Philadelphia, the Coroner has both of his physicians present at the autopsy, so that the testimony is stronger; and in case of absence of one of the physicians the other can go on the witness stand, and the case not be postponed.

In Germany the legal evidence of a post-mortem held by gas-light has been adjudged by the court, except under certain peculiar circumstances, to be void.

You should familiarize yourself with the medical laws of the State in which you practise. In some States the law obliges the physician to state professional secrets after the death of the patient on the demand of the heirs-at-law.

If you value your peace of mind do not put yourself forward as an expert witness in medico-legal matters. Knowledge which you already have should be freely given to the court in criminal cases, but the court cannot compel you to obtain expert knowledge without your consent.

Instruments for an Autopsy.

A post-mortem set with its box is more of a luxury than a necessity. With the exception of removing the brain and cord, an autopsy can usually be made with a penknife. A post-mortem can be made with the hand, through the rectum, without even the use of a knife.

The following instruments are to be found in a post-mortem set: Those marked with a star are the most important; those with a dagger can be dispensed with without any difficulty.

* One large and one small section or cartilage knife. The knife should be strongly made; there is no necessity for an expanded and flattened portion on top of the blade for the index finger to rest upon. Of all things, a sharp-pointed knife is to be abhorred. Post-mortem wounds usually occur from three sources: first, from sharp-pointed knives—the wound being an incised wound; second,

from scratching your hand on bone, as when the sternum is broken, or upon the first rib. The nature of this wound is more that of an inoculation, as is seen in vaccination; third, from someone else cutting you while assisting in opening the head or elsewhere.

* A scalpel such as is found in your dissecting-cases.

A brain knife, which should have a long thin blade. Wet before using.

† A costotome. This instrument is expensive.

* Dissecting forceps.

Two pairs of scissors, * one having a rounded end.

Enterotome, one end being curved upon itself and not sharp, with a shorter blade above.

A blow-pipe.

Several probes. A piece of broom-grass makes a good probe.

* A saw. Be sure to have the blade attached to the handle. They are often made in two pieces and are apt to be loosened.

† A Hey's saw, useful for sawing the angles in opening the skull.

A tenaculum.

A metal catheter.

A mallet or steel hammer; the end should have a blunt hook for the removal of the skull-cap,

Steel chisel with a guard about one-half inch from the blade end, to prevent injury to the brain. It may have a cross-bar as on a corkscrew, and can then be used in a twisting manner to remove the skull-cap.

† A straight steel chisel for removing spinal cord.

† Pair of good bone-forceps.

* Carpet needles of good size.

Caliper compasses or pelvimeter.

A steel spring measure.

Graduated cones.

Graduated glasses; * one large and one small.

A pair of scales.

Litmus paper.

Lugol's solution.

* A good hand-glass.

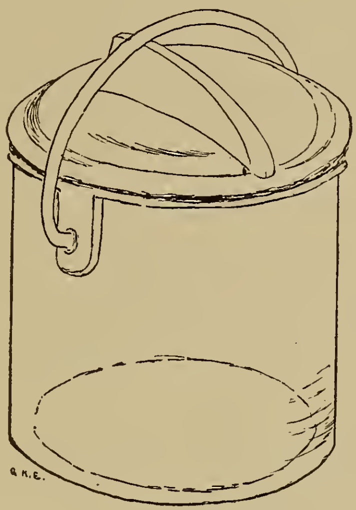
† A portable steel tripod rest for the head.

The following instruments can be purchased for about $5.00, and kept rolled up in a chamois skin ready for use:

A large section knife and a scalpel.
Enterotome.
Chisel.
Saw.
Large needle.
Pair of scissors.

A well-apportioned mortuary room, such as is seen at the University, should contain a table upon which are to be placed the instruments, scales, plates, etc. Plenty of running water, a spigot being arranged above the post-mortem table so as to allow the water to flow directly on the body. The table should be about seven feet long, two feet nine inches high, and drain toward the centre by means of a depression, which should be connected with

FIG. 46.



a drain and a ventilating shaft. For class purposes the table should revolve, and, by an ingenious arrangement of a fulcrum and lever attachment, the weight of the body can be determined. A skylight above and a billiard-table gaslight should be directly over the table. A block for the head, or the rest used by the undertaker, should be provided. A wooden board for the examination of the organs should be provided for section work, as they slip when placed upon the slab. A sink for washing out the intestines, or if this is not at hand, a bucket and washbasin. Museum jars or preserving jars (as in Fig. 46) and bottles containing different percentages of alcohol and Müller's fluid should be on hand.

It is the custom in this country and in England to give the weights of the organs in avoirdupois ounces, their dimensions in inches, and capacity in cubic inches, though the Continental method of using grammes, centimetres, and cubic centimetres is fast gaining ground. Troy weight is sometimes used, and may give rise to much confusion. The grain is the same in both.

An ounce avoirdupois is equal to 437.5 grains, or 28.3 grammes.

An ounce Troy (or apothecaries' weight) is equal to 480 grains, or 31.1 grammes.

To convert grammes into avoirdupois divide by 28.3 ; into Troy, by 31.1. Conversely, to convert avoirdupois into grammes, multiply by 28.3 ; into Troy, by 31.1.

A kilogramme equals 1000 grammes.

A gramme equals 1000 milligrammes.

A litre equals 1000 cubic centimetres, or 61.027 cubic inches, which is equivalent to 2.113 American pints or 1.76 English pints.

A metre equals 1000 millimetres, or 39.37 inches.

The weights and sizes of the important organs and structures of the body are given in the following tables (from Ziegler):

I. Average height (European standard):

Adult male, 172 centimetres.
Adult female, 160 centimetres.
Newborn male, 47.4 centimetres.
Newborn female, 46.75 centimetres.

A child at two years is about one-half as large as it will ever be.

II. Average weight (European standard):

Adult male, 65 kilogrammes.
Adult female, 55 kilogrammes.
Newborn child, 3250 grammes; the male being usually slightly the heavier.

The English and American insurance standard (from Finlayson's *Clinical Manual*):

	Stones.	Pounds.
A man of 5 feet should weigh . .	8 to 9	120
A man of 5 feet 3 inches should weigh	9 to 10	130
A man of 5 feet 6 inches should weigh	10 to 11	143
A man of 5 feet 9 inches should weigh	11 to 12	155
A man of 6 feet should weigh . .	12 to 14	170

A stone is equal to 14 pounds.

According to Orth, the mean height of a full-term, sound child is between 50 and 51 centimetres, the male being slightly longer than the female. The weight of a full-term boy at birth is 3600 grammes, of a girl 3250 grammes. For the last five lunar months of fœtal life, if the height expressed in centimetres be divided by five, the approximate age of the child in lunar months will be obtained. For example, if the child measures 35 centimetres, divide this by 5, and we have 7 as the number of lunar months which the child has passed *in utero*. The fœtal age of the child in the first 5 months represents about the square root of the height expressed in centimetres. For example, if the height is 16 centimetres, the child is 4 lunar months old.

III. The approximate weight of the internal organs :[1]

	Adult. grammes.	Newborn. grammes.		Adult. grammes.	Newborn. grammes.
Brain . .	1397	385	Left kidney .	150	—
Heart . .	304	24	Both kidneys	299	23.6
Lungs . .	1172	58	Testicles .	48	0.8
Liver . .	1612	118	Muscles .	29,880	625
Pancreas .	201	11.1	Skeleton .	11,560	445
Right kidney	141	—			

IV. The body weight by percentage :

	Adult. per cent.	Newborn. per cent.		Adult. per cent.	Newborn. per cent.
Heart . .	0.52	0.89	Liver . .	2.77	4.39
Lungs . .	2.01	2.16	Brain . .	2.37	14.34
Stomach and alimentary canal .	2.34	2.53	Thymus gland	0.0086	0.54
			Skeleton .	15.35	16.7
			Muscles .	43.09	23.4
Pancreas .	0.346	0.41			

V. The weights, according to Gray's *Anatomy*, American edition by Keen, expressed in avoirdupois ounces and in grains :

The average normal weight of the

	Male.	Female.
Brain	49½ ounces.	44 ounces.

It is heavier than in any animal except the elephant, 8 to 10 pounds ; and in the whale, 4 to 5 pounds.

[1] Tables are from Vierordt, quoted by Ziegler, 7th ed., vol. 1, p. 181, German edition.

The spinal cord freed from membranes and nerves weighs $1\frac{1}{2}$ ounces, or, in proportion to the encephalon, 1 to 33.

	Male.	Female.
Heart . .	10 to 12 ounces.	8 to 10 ounces.
	To body weight, 1 to 169.	To body weight, 1 to 149.

Pathologically, the heart may weigh over 1000 grammes.

Lungs, both weigh 42 ounces, the right being 2 ounces heavier than the left; proportion to body weight, in male as 1 to 37, in female 1 to 43. In pneumonia one lung may weigh 4 or 5 pounds, or in atelectasis the weight may be but several ounces.

	Males.	Females.
Kidneys . . .	$4\frac{1}{2}$ to 6 ounces.	4 to $5\frac{1}{2}$ ounces.
	Supra-renals, 60 to 120 grains.	

Liver, 50 to 60 ounces; according to Leidy, $\frac{1}{5}$ to $\frac{1}{6}$ less than in the female. At birth it is nearly twice as large in proportion to the body-weight as in the adult. Spleen (very variable), 7 ounces.

The testicle, 6 to 8 drachms, the left being slightly the heavier.

Thyroid gland, 1 to 2 ounces.

Thymus at birth, $\frac{1}{2}$ ounce.

Pancreas (very variable)—several ounces (2 to 6).

Prostate, 6 ounces.

Uterus, 1 to $1\frac{1}{2}$ ounces.

Ovaries, 1 to 2 ounces.

Stomach, $4\frac{1}{2}$ ounces.

VI. Dimensions[1] of the important organs:

Brain.

Volume, 1330 cubic centimetres.

Specific gravity, 1035 to 1040.

Length: man, 160 to 170 millimetres.

" woman, 150 to 160 millimetres.

Greatest transverse diameter, 140 millimetres.

" vertical diameter, 125 millimetres.

Heart.

Thickness of the right ventricle, 2 to 3 millimetres; pathologically being at times 7 to 10 millimetres. Left ventricle, 7 to 10 millimetres; pathologically, 20 to 25 millimetres.

[1] From Orth.

Measurements of the normal heart.[1]

Diameter of orifice, aortic, 0.9 to 1 inch.
Mitral, 1.2 to 1.4 inch (two fingers).
Pulmonary, 1.1 to 1.2 inch.
Tricuspid, 1.5 to 1.8 inch (three fingers).

Spleen.

Volume, 221.5 cubic centimetres.
Length, 12 to 14 centimetres.
Breadth, 8 to 9 centimetres.
Thickness, 3 to 4 centimetres.

Kidney.

Length, 11 to 12 centimetres.
Breadth, 5 to 6 centimetres.
Thickness, 3 to 4 centimetres.
Or in the proportion of $1 : \frac{1}{2} : \frac{1}{3}$.

Liver.

Volume, 1574 cubic centimetres.
Transverse diameter, 25 to 30 centimetres.
Right lobe, 18 to 20 centimetres.
Left lobe, 8 to 10 centimetres.
Longitudinal diameter: right, 20 to 22 centimetres.
" " left, 15 to 16 centimetres.
Greatest thickness, 6 to 9 centimetres.
A fatty liver may be so light as to float on water.

The adult alimentary tract is about thirty feet in length, the small intestine being about twenty feet long, and the large intestine about five feet in length. Much variation from these figures occurs; the writer has seen the sigmoid flexure become dilated and push up the diaphragm, or form a part of a complete inguinal hernia of the *right* side. The large intestine will hold about three litres, and the small intestine an equal amount; the œsophagus and stomach about two litres.

The method of telling the right lung from the left is by the

[1] From Hamilton.

right having three lobes. This is very constant, the writer only recalling one case out of many hundreds where the opposite condition prevailed. As the student is apt to get confused upon which side the three lobes are, it can be remembered in connection with the tricuspid and mitral valves—tricuspid (three valves) right side, mitral (two valves) left side; this corresponds to the number of the lobes in the lung upon the same side.

The apex of the lung, with its tapering cone, can usually readily be told from the concave and broad base. After determining this, remember that on the right side, from above downward, we have bronchus, pulmonary artery, and pulmonary veins; while on the left side it is pulmonary artery, bronchus, and pulmonary vein.

The method of telling the right kidney from the left depends upon the following anatomical data:

Right kidney.	*Left kidney.*
Impressio renalis from liver.	No impressio renalis from spleen.
Shorter and broader.	Longer and narrower.
About 5 to 7 grammes lighter.	About 5 to 7 grammes heavier.
The spermatic or ovarian vein empties into the inferior vena cava.	The spermatic or ovarian vein empties into the renal.

The posterior surface of both kidneys is flatter than the anterior, the external border being convex and the internal border concave, and the top more expanded than the lower portion. At the hilum, the arrangement of the vessels of the kidney is—from above (anteriorly), downward (posteriorly)—vein, artery, ureter (V A U). The kidney is placed upon the table in front of the examiner on its posterior surface, with its lower extremity toward the observer, and the ureter pointing downward. The ureter is then behind and below the other vessels, the hilum being directed to the side of the operator to which the kidney belongs, *i. e.*, if toward the left hand of the observer, it is the left kidney, and if toward the right hand it is the right kidney.

Other methods of telling the right-sided organs from the left will at once suggest themselves, as, placing the right-sided organs on the right side of the body, and the left-sided organs on the left side. This is subject to confusion from change. The writer has found it very convenient to nick the left-sided organs with one nick or cut, as the left-sided organs are first removed from the body, and the right-sided organs with two nicks or cuts, and they can thus be readily distinguished the one from the other.

Order of Examination in an Autopsy, and what should be looked for.

(Based largely on Virchow's and Orth's works on the subject.)

A. *External Examination.*

In medico-legal cases this is often of the most importance, while in medicine the internal examination of the body is more instructive.

1. External inspection of the body in general.
   - *a.* General bodily relations. Age, sex, height; various dimensions of the body, such as head, chest, waist, arms, limbs, etc.; nutrition, weight.
   - *b.* The signs of death and decomposition. Rigor mortis, post-mortem lividity.
2. Data of interest to Coroner, such as position of the body, wounds, fluids scattered around, etc.
3. External inspection of each individual part of the body, as hair, eyes, nose, ears, extremities, penis, etc., and for jaundice, diseased joints, contractures, œdema, hernia, hydrocele, etc.
4. External inspection of the newborn. Signs of inflammation of the cord, ophthalmia neonatorum, hæmatoma, dislocations and fractures, the state of the fontanelles, mastitis, hernia, especially umbilical, spina bifida, pemphigus, thrush, icterus, cyanosis and malformation, such as hare-lip, cleft palate, tongue-tie, polydactylism, monstrosities, abnormal openings, imperforate anus and rectum, etc.
5. Diseases of the skin and of the underlying tissues.
   - *a.* General alterations.
     1. Epidermis.
     2. Cutis.
   - *b.* The individual ailments.

B. *Internal Examination.*

I. Spinal Column.

1. Soft parts and bones.
2. Spinal cord and its coverings.
   - *a.* General relations.

b. The individual diseases of the—
1. Dura mater.
2. Pia mater.
3. Spinal cord.

II. Head.

Scalp, thickness, vascularity, etc.

1. Periosteum.
2. Bones (from without).
    a. General relations.
    b. Individual diseases.
3. Bones (from within).
4. Dura mater (convexity from without).
    a. Dura itself.
    b. Longitudinal sinus.
5. Dura mater (convexity from within).
    a. General relations.
    b. Diseases common to it.
6. Pia mater (convexity).
    a. General relations.
    b. Diseases common to it.
7. Removal of the brain.
8. Pia mater of the base.
    a. Its large vessels.
    b. The pia mater itself.
9. Brain (from without).
10. Internal examination of the brain and its ventricles.
    1. Abnormal contents and enlargement of the ventricles.
    2. Ependyma.
    3. Choroid plexus.
        a. Sections of the cerebrum.
    1. Section of the hemispheres.
    2. Sections of the greater ganglia.
        b. Fourth ventricle.
        c. Cerebellum.
        d. Pons Varolii and medulla oblongata.
        e. Different methods of dissecting the brain.
        f. Microscopical examinations of the brain.
        g. Diseases of the brain.
11. Dura mater and bones of the base of the cranium.

12. Face.
    a. Parotid gland.
    b. Bones of the face.
13. Nostrils.
14. Eyes.
    a. Retina.
    b. Choroid.
    c. Eyeball.
15. Organs of hearing.

III. Thorax and Abdomen.

1. External soft parts.
    a. Panniculus.
    b. Muscles.
        1. General relations.
        2. Individual diseases.
2. Inspection of the abdominal cavity.
    a. Relation of organs.
    b. Color (amount of blood).
    c. Abnormal contents.
    d. Peritoneum.

A. *Section of thorax.*

1. External inspection.
    a. General relations.
    b. The various bones.
2. Opening of thorax.
3. Bones of sternum from within.
    a. Sternum.
    b. Ribs.
    c. Sterno-clavicular articulation and clavicle.
4. Inspection of the thoracic cavity.
    a. Appearance of exposed lung tissue.
    b. Pleural cavities.
5. Mediastinum (middle) and contents.
    a. Tissues.
    b. Mediastinal lymphatic glands.
    c. Thymus gland.

6. Pericardium.
    a. Contents.
    b. Diseases (pathological changes).
    c. Sub-pericardial adipose tissue.
7. Heart.
    a. External inspection.
    b. Opening *in situ.*
    c. Blood.
    d. Removal of heart and continuation of dissection.
    e. Internal exploration of the heart.
        1. General relations.
        2. The various diseases.
8. Lungs.
    a. Pleura.
    b. Opening *in situ.*
    c. Internal inspection of the lung.
        1. General relations.
        2. The various diseases.
            a. Of the parenchyma and the smaller bronchi.
            b. Of the larger bronchi.
            c. Of the vessels of the lung.
            d. Of the bronchial lymphatic glands.
9. Costal pleura and posterior sections of ribs.
10. Organs of the neck.
    a. Method of dissection.
    b. Observation of the various parts.
        1. Large vessels and nerves.
        2. Mouth and pharynx.
        3. Œsophagus.
            a. General relations.
            b. Various diseased conditions.
        4. Larynx and trachea.
            a. General relations.
            b. Various diseases.
            c. Examination of sputum.
        5. Submaxillary glands.
        6. Thyroid glands.
        7. Lymphatic glands of the neck.
11. Deep muscles of the neck and cervical vertebra.
12. The lung test of newborn infants.

B. *Section of abdominal cavity.*

1. Anterior layer of peritoneum.
2. Mesenteries.
3. Spleen.
    a. External observation.
        1. General relations.
        2. Capsule of spleen.
    b. Internal observation.
        1. General relations.
        2. Various diseases.
4. Kidneys and adrenals.
    a. Adrenals.
    b. Kidneys.
        1. Capsule of kidney.
        2. Examination of the parenchyma.
            a. General relations.
            b. Peculiar changes.
        3. Internal examination of the parenchyma.
            a. General relations.
            b. Various pathological changes.
        4. Tufts, pyramids, calyx, ureters.
5. Urinary organs.
    a. Capacity of bladder and contents.
    b. General dissection method.
    c. Bladder and urethra.
        1. Bladder.
            a. General relations.
            b. Various diseases.
        2. Urethra.
    d. Penis.
    e. Prostate gland.
    f. Seminal duct and spermatic cord.
    g. Testicles, rete testis and spermatic cord.
        1. Vas deferens and tunica vaginalis.
        2. External examination of testicles and rete testis.
        3. Internal examination of testicles and rete testis.
    h. Vulva.
        1. General relations.
        2. The various diseases.
    k. Uterus.

1. External examination.
2. Internal examination.
    - *a.* General relations.
    - *b.* Various diseases.

l. Broad ligaments and parametrium.

m. Tubes (Fallopian).

n. Ovaries.

1. External examination.
2. Internal examination.

o. Douglas' pouch or retro-uterine peritoneum.

1. Extra-uterine pregnancies.

p. Rectum.

1. General relations.
2. Various diseases.

6. Duodenum and stomach.

a. External inspection.

1. General relations.
2. Changes of the serosa.

b. Internal examination.

1. Contents.
2. Mucous membrane of duodenum.
3. Mucous membrane of stomach.
    - *a.* General relations.
    - *b.* Various diseases.

c. Examination of the stomach in suspected poison cases.

1. Examination method.
2. The changes produced by poisons.

7. The duodeno-hepatic ligament.

a. Ductus choledochus.

b. Portal vein.

8. Gall-bladder and liver.

a. Gall-bladder.

1. External examination.
    - *a.* General relations.
    - *b.* Serosa.
2. Internal examination.
    - *a.* Contents.
    - *b.* Position.

b. Portal opening and lymphatic glands.

c. Liver.

1. External observation.

a. Capsule of liver.
b. General relation.
2. Internal examination.
a. General relation.
1. The parenchyma as a whole.
2. The various lobules.
b. The various diseases.
9. Pancreas.
a. Gland parenchyma.
b. Pancreatic ducts.
10. Cœliac ganglion.
11. Mesenteries.
a. Connective tissue of.
b. Mesenteric lymphatics.
c. Large vessels of the mesentery.
12. Intestines.
a. External observation.
1. General relations.
2. Serosa.
b. Opening of the intestines.
c. Contents of the intestines in an examination of same.
d. Position and volvulus of intestines.
1. General relations.
2. Various diseases.
13. Great vessels and the accompanying lymphatic glands.
a. Veins.
b. Arteries, especially aorta.
1. General relations.
2. Various diseases.
c. Retro-peritoneal lymphatic glands.
d. Thoracic duct.
14. Internal muscles of the body.
a. Diaphragm.
b. Ilio-psoas.
15. Cervical vertebræ (from within).
a. General relations.
b. Various diseases.

IV. Extremities.

1. Lymph glands.
2. Lymph vessels.

3. Vessels.
4. Nerves.
5. Muscles.
    a. General relations.
    b. Various diseases.
6. Joints.
    a. External examination.
    b. Internal examination.
        1. Contents.
        2. Internal ligaments.
        3. Synovial membranes.
        4. Joint surfaces.
        5. The various diseases of joints as a whole.
7. Bones.

1. General examination of bones as a whole.
2. Examination of bones individually and in parts.
    a. Periosteum.
        1. General relations.
        2. Various diseases.
    b. Tela ossea.
        1. General relations.
        2. Various diseases.
    c. Marrow.
        1. General relations.
        2. Various diseases.
3. Diseases of the bones as a whole.

Heading for a Post-mortem Book.

A post-mortem book should be prepared for each hospital, and the notes should be made while the autopsy is in progress. The following printed words may be placed at the top.

Number of autopsy, Name,
Age, Sex, Color,
Address,
Occupation, Married or Single,
Nationality, Place where held,
Commenced autopsy, (hour) (day) (month)
Ended (hour) (minute)
If hospital : Ward, No. of bed,

First visit in last sickness, , 189 Died,
Autopsy commenced hours after death.
Weather: cold, mild, or hot.
Mode of death: sudden or slow.
Clinical diagnosis,
Attending physician,
Physicians present at autopsy,
Permission given by
Performed by
Pathological diagnoses,

Specimens taken,
Character of preservative fluid,

Order for the Examination of the Various Parts of the Body.

1. Examination of the exterior of the body.
2. Examination[1] of the abdominal cavity.
3. Examination[1] of the thoracic cavities.
4. Pericardium.
5. Arch of the aorta.
6. Heart.[2]
7. Nares, larynx, and trachea.
8. Lungs. Left. Right.
9. Spleen.
10. Intestines.
11. Left adrenal and semilunar ganglion.
12. Left kidney.
13. Right adrenal and semilunar ganglion.
14. Right kidney.
15. Ureters.
16. Bladder.
17. In the male: Prostate, spermatic cord, urethra, testicles, etc.
    In the female: Uterus, tubes, ovaries, broad ligament, etc.
18. Duodenum.
19. Stomach and œsophagus.

[1] At this time none of the organs are to be removed from the body or their relations markedly disturbed.
[2] After the heart is opened it is wise to have someone start on the head.

20. Liver.
21. Pancreas.
22. Retro-peritoneal glands, thoracic ducts, aorta, vena cava, etc.
23. Head. *a.* Membranes. *b.* Brain. *c.* Eye. *d.* Ear.
24. Spinal cord.
25. Other organs.
26. Remarks.
27. Microscopic examination.

Preparation for an Autopsy.

Place. The manner in which the autopsy is made will depend, to a certain degree, upon the place where it is held, as when

1. At a private house or at the undertaker's.
2. At the hospital or morgue.

1. If an adult, the coffin-lid, or, still better, the coffin turned upside down, a door taken from its hinges and placed on two chairs, a kitchen table; or, if a child, the marble slab from a bureau will afford a resting-place for the body. Do not have the body too low, as the stooping position, if too long continued, causes intense pain in the back.

Bring with you a post-mortem set, dissecting apron, surgeon's coat, two sponges, a graduate holding at least one-half pint, needle and carpet thread to sew up body, piece of rubber like that used in confinement cases, piece of oil-silk or have a special bag so prepared that fluid will not escape from it, note-book and pencil, bromine, celloidin in solution, small roll of cotton, four small two-ounce bottles with broad mouths for microscopic specimens—have one filled with 70 per cent. alcohol, one with 95 per cent., another with Müller's fluid, and the fourth with a saturated solution of bichloride of mercury. Ask for two buckets of water, half filled, an empty basin, and a half-dozen towels.

If possible, the post-mortem should be made before the body is dressed for the funeral. Get the relatives, friends, and, if possible, the undertaker out of the room before commencing the autopsy. A surgeon's coat and an apron, with the sleeves well rolled up, and you are ready for work. The undertaker has usually spread a piece of mackintosh on the floor; if not, an old piece of carpet should be requested for this purpose. The autopsy is then made in the order described on pages 107 and 108, and in the manner directed in the following pages.

In private cases your skill as a pathologist will be frequently judged of by the neatness with which you sew up the body and the care with which you clean up after the autopsy is completed. Be sure to leave no blood-stains behind.

2. In the hospital or morgue everything is arranged much more completely, and the autopsy can, therefore, be conducted more easily, more comfortably, and better.

I. Examination of the Exterior of the Body.

It would be well if this was done more frequently and thoroughly during life, as valuable information can frequently be discovered in this manner. Get all the information you can from the physician, friends, police, etc. People like to talk, and it is surprising how much one can learn in this manner. Notice especially the state of nutrition of body; weight; circumference of the shoulders and head; height (in a child take the ordinary fœtal measurements and examine the fontanelles, sutures, etc.); appearance of the skin, such as eruptions, scars, wounds, bruises, etc.; deformities; other peculiarities, such as jaundice, œdema, hernia, hydrocele, etc.; rigor mortis; decomposition; post-mortem lividity. Discharges from the various orifices, such as ear, nose, mouth, vagina, urethra, etc., should be carefully observed and note made of any foreign bodies inside of them.

Look for bedsores, external parasites, such as pediculi,[1] color of hair, eyes (remember that jaundice can best be told in the conjunctiva, and that, as the eyes are closed by the undertaker, they should be carefully shut after the examination has been completed), scars on the genitalia, mucous membrane of the mouth, teeth, breast, distention of the lineæ albicantes, thickening of the periosteum of the leg, amount of fat, petechiæ, muscular development, wasting of muscles, skin of the throat.

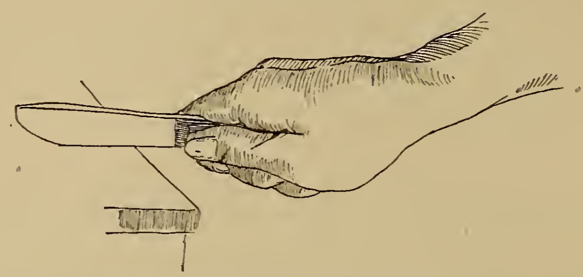
The external examination is of the utmost importance in all medico-legal cases, and great care should be exercised in a thorough description of the surroundings, such as in a case of cut throat, whether the razor was held in the hand, or found upon the right side of the body, or whether the person had committed suicide while looking into a glass, etc.

The operator stands upon the right side of the body. A block

[1] By means of a towel soaked in chloroform and placed upon the head, pediculi can be quickly and safely disposed of.

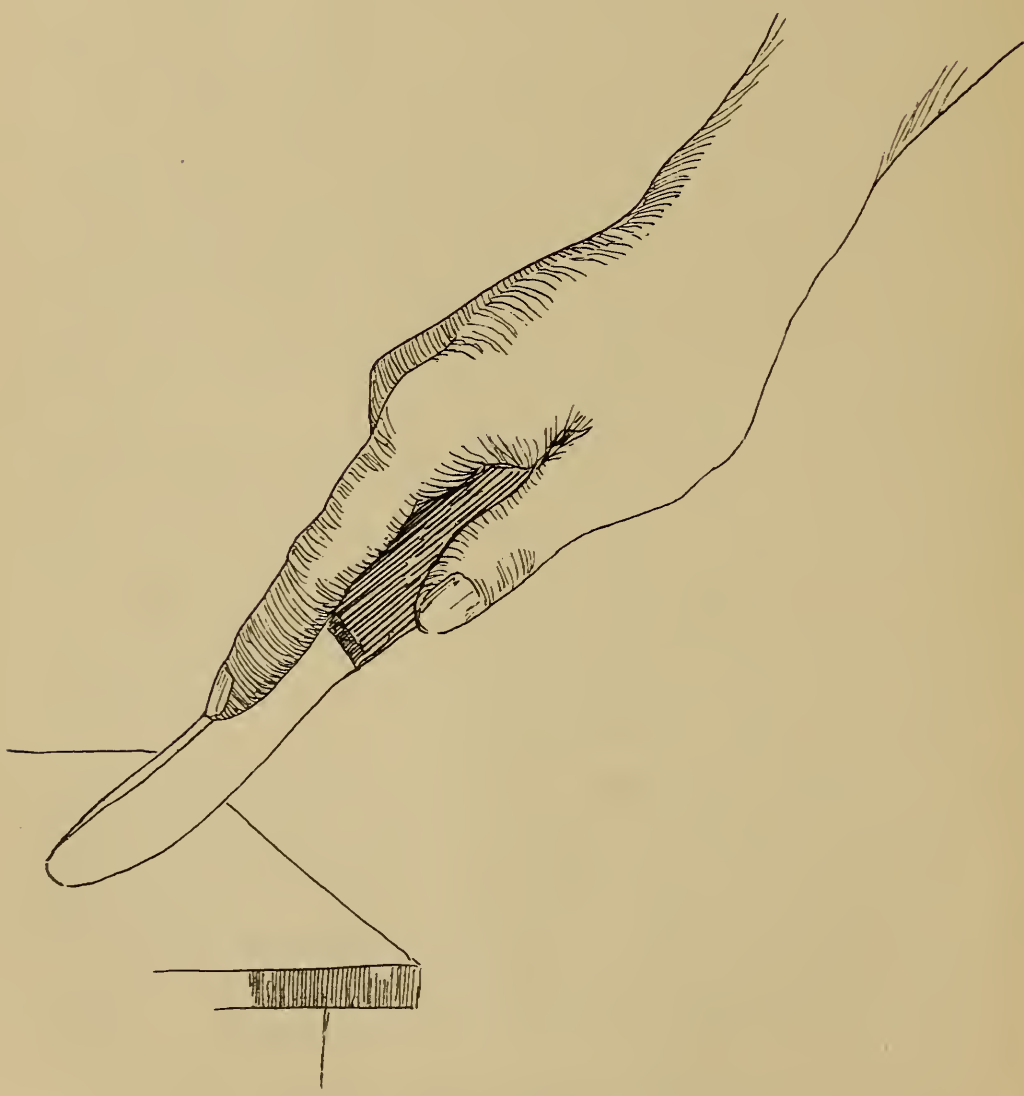
can be placed under the shoulders to elevate them if it be desired to do so. Holding the knife as in Fig. 47 or Fig. 48, he makes

FIG. 47.



Method of holding the large section knife for the primary incision.

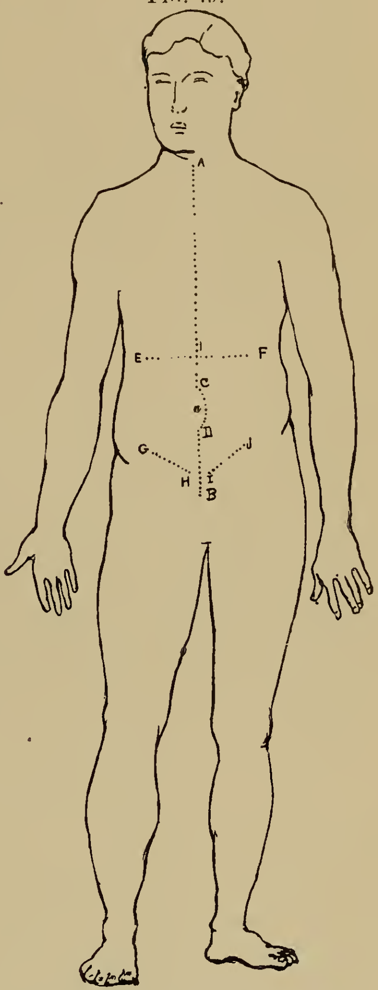
FIG. 48.



Another method of holding the section knife.

a clean cut from the inter-clavicular notch to the symphysis pubis, going to the left of the umbilicus, care being taken that the knife does not penetrate into the abdominal cavity. (Fig. 49.) The muscles are then dissected away from the sternum and ribs, and an opening is made through the peritoneum below the xiphoid cartilage, and the index finger and the middle finger are introduced, assuming an inverted V. The skin and muscles are then raised, and, the knife being introduced into the opening, the left hand is slid along as the knife cuts its way through the tissue, the cutting being done from within outward. In order to have still more room various means have been suggested, the two which are most applicable being the transverse incision on each side, about three inches above the umbilicus; there will then be four flaps instead of two. Another method, which is easily accomplished and gives considerable room, is to cut the recti muscles near and in the direction of Poupart's ligament. It will not be found necessary to make both the transverse incisions and those of the recti.

FIG. 49.



The primary incision, A B, going to the left of the umbilicus at C D; the secondary transverse incision, E F, making four flaps; or the secondary incision, cutting the recti, G H and I J, from beneath, and not the skin.

The hands should be washed from time to time, as the feeling imparted to the skin by means of dried blood is disagreeable.

If you are so unfortunate as to cut yourself, wash the wound with running water four or five minutes, and then dress antiseptically. Do not, out of bravado, go on with the post-mortem if there be anyone else present who can complete it. The action of the direct rays of the sun upon wounds produced by certain micro-organisms is worthy of note and affords an opportunity for further investigation. If the case is one where micro-organismal infection be not feared, the post-mortem may be continued, a small piece of cotton being placed over the wound and attached to the skin by means of cel-

loidin or flexible collodion. Post-mortem gloves, with long sleeves, are to be had in the stores. If you are attending a post-mortem where the operator is using these gloves be sure that he does not injure you, as the grasp of the knife is by no means so firm as when held in the naked hand.

The rectus muscle is then examined for color, consistency, hyaline patches, encapsulation of trichinæ spirales, etc.

The muscles being thoroughly removed from the thorax by grasping the skin with the left hand and cutting, with the knife in the right hand, with a long, sweeping movement, the clavicle is grasped and moved in order to discover the situation of the articulation with the sternum; the ligaments are then cut upon each side. The ribs are incised from within outward by means of the cartilage knife or costotome, care being taken to cut the cartilage rather than the bone, the point of union being quite marked. The first rib is the only one that will give any trouble, and this, being completely united to the sternum by means of ossification, should be cut through by the costotome or saw. The sternum is then raised and the diaphragm and other adhesions cut as closely as possible to the bone. In order to prevent scratching the hands the flaps are laid over the cut ends of the ribs.

II. Examination of the Abdominal Cavity.

In this examination none of the organs are to be removed from the body or in any way disturbed, so that their normal relations may, too, be again studied. Care should be exercised in examining the color of the organs, such as the liver, before they may have become oxidized. This is especially striking upon section of organs such as the spleen or lungs. The relative position of all the organs should be carefully observed, such as the situation of the liver, stomach, and other viscera to the costal and xiphoid cartilages. Perforation, volvulus, intussusception, concealed hernia, tumors, aneurism, contents of the bowels, whether fecal or air, points of adhesion, any signs of inflammation; the extent of the diaphragm; fluid, if any; situation and condition of the vermiform appendix; gall-stones; estimated amount of urine in the bladder; pregnancy, pus tubes, etc., if a woman.

III. External Examination of the Thoracic Cavity.

For the sake of uniformity, it is wise to examine the left-sided double parts or organs first. Notice here the amount of fluid—see

if it be blood—position, distention, color, and general appearance of the lungs. Break up any adhesions which may be present, and introduce the hand posteriorly to the lungs and gently feel for pulmonary lesions, etc. Any fluid found should be carefully measured. Determine whether it is inflammatory or not.

See the condition of the mediastinum, thymus gland, peri-bronchial glands, which are often pigmented, and mistaken by the student for melanotic sarcoma. The thyroid gland can now be examined, or, if desired, the tongue, epiglottis, œsophagus, trachea, thyroid gland, etc., can be removed later on in a single piece. Notice the position of the pericardium; see if it is distended with fluid, etc. Search for an aneurism.

IV. Pericardium.

The pericardium is elevated by means of the fingers or a tenaculum, and a small incision is made at its highest point, care being taken not to allow the escape of any fluid. Measure the amount of fluid. This can be readily withdrawn by means of a pipette, a syringe, or a small graduated glass. Examine situation of the heart, looking especially at the distention of the cavities with blood. See if there be pericarditis, tubercles, etc. The normal amount of pericardial fluid is about fifty cubic centimetres. Blood from a ruptured aneurism may fill the pericardial sac.

V. Arch of the Aorta.

This should always be carefully examined, as when an aneurism is present it is usually advisable to remove the aorta attached to the heart.

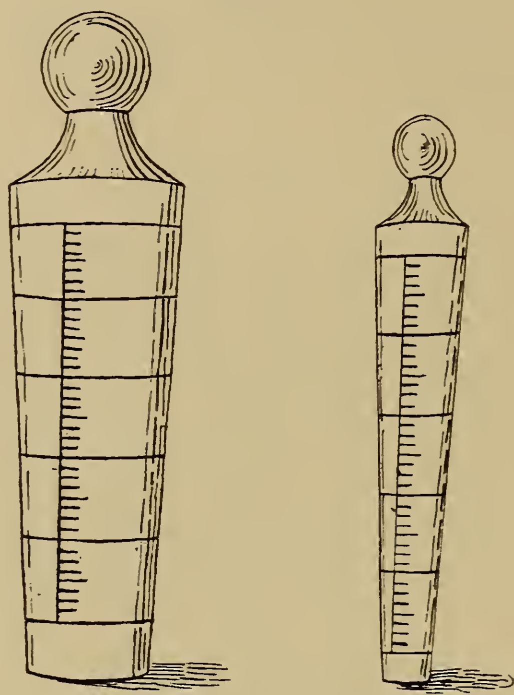
VI. Heart.

Method of Opening Heart (after Virchow).

With a knife make an incision in the right auricle, midway between the superior and inferior venæ cavæ, in the direction of the right ventricular ridge. Continue this incision in the same direction until the right auriculo-ventricular septum is reached. Examine the auricle for clots and determine the calibre of the right auriculo-ventricular opening, guarded by the tricuspid valves. In case this opening is occupied by a clot, the clot should be removed. The size of the opening is usually determined by

the number of fingers which can pass through the opening, though the graduated cones (see Fig. 50), or different sized balls placed on rods, should be employed. Next make an opening in the right ventricle just below the auriculo-ventricular septum and the opening made in the auricle. Continue this incision down the right ventricular ridge until the ventricular septum is reached, which is a little to the right of the apex. The character of the clots in the ventricle is next determined.

FIG. 50.



Graduated cones used for measuring orifices. (HAMILTON.)

On the left side make an incision in the left auricle, in or slightly below the lowermost pulmonary vein. Continue the incision in the direction of the left ventricular ridge, stopping at the auriculo-ventricular septum. Examine the auricle for clots and determine the calibre of the left auriculo-ventricular opening, guarded by the mitral valve. An incision is next made in the left ventricle, along the entire length of the left ventricular ridge. It will be remembered that the left ventricle normally forms the apex of the heart; therefore the incision will be carried through the apex before the ventricular septum will be reached. Examine the ventricle for clots. All of the above incisions are made while the heart is *in situ* in the body, and they may, therefore, be called the primary incisions of the heart.

The heart is next to be removed from the body. For this purpose introduce the index finger of the left hand into the left ventricle and the thumb of the same hand into the right ventricle. Grasp the ventricular septum near the apex and elevate the heart, making slight traction on the bloodvessels. With a knife in the right hand cut everything which normally holds the heart to the body, viz., the inferior venæ cavæ, the superior venæ cavæ, the pulmonary artery and aorta (near their exit from the cavity of the pericardium, first, however, having determined that there is no aneurism), and, lastly, the pulmonary veins. The competency of the pulmonary and aortic valves is next tested by means of the introduction of water into the pulmonary artery and the aorta, the heart being evenly suspended by means of the great vessels. See that the coronary arteries are intact, or otherwise the water may run out through them, and the aortic valves will be stated to be incompetent.

Lay the heart upon a board or hold it, with its posterior surface down, upon the left hand. Introduce a pair of probe-pointed scissors or a cardiotome in the centre of the right ventricular incision, and cut toward the centre of the pulmonary artery. There are two anterior semilunar valves, and their junction can usually be seen from the outside; if not, their junction can readily be determined by looking into the pulmonary artery or by the introduction of the index finger. When practicable it is best to cut through their attachments. Continue the incision through the cut end of the pulmonary artery. Examine the pulmonary valves, endocardium, muscle, chordæ tendineæ, etc. Dissect away the connective tissue which holds the pulmonary artery and aorta together. In the left ventricle cut the anterior ventricular wall as near the ventricular septum as possible until a point is reached where the left auricular appendage overlaps on to the left ventricle. The scissors are then introduced into the aorta (either from the aorta or ventricle) and the incision is made between two leaflets. Bear in mind that there is but one anterior leaflet, and the incision will, therefore, have to be made toward one side or the other. Examine valve, muscle, intima of aorta, etc. Next dissect out the coronary arteries. Lastly, upon both sides continue the auricular incisions into the ventricular, and thus complete the secondary incisions made outside of the body. It will be found that the mitral and tricuspid valves are not injured, and the entire heart can be folded together so as to again show its normal contour.

The incisions used in opening the heart are shown by using the letters seen in Figs. 51, 52, and 53.

Primary Incisions.

Make the incision A B in the right auricle, midway between the superior and inferior venæ cavæ, in the direction of the right ventricular ridge, stopping at the auriculo-ventricular septum. Starting in the ventricle, near the auriculo-ventricular septum, make the incision C E down the right ventricular ridge to the ventricular

FIG. 51.

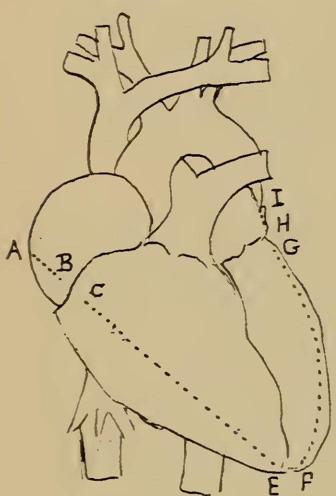


FIG. 52.

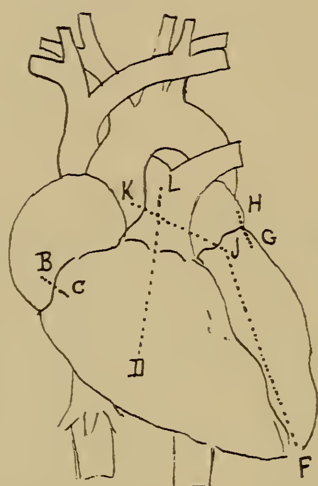


FIG. 53.

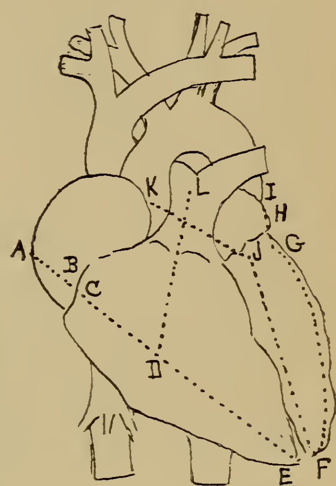


Fig. 51.—Lines showing the incisions which are to be made in the heart while it is in the body. These may be called the primary incisions, A B, C E. I H, and G F.

Fig. 52.—Lines showing the incisions which are to be made in the heart outside of the body. These may be called the secondary incisions, and can be divided into two sets—first, those for examining the ventricles and the arteries leading therefrom, D L and F J, and J K. and the second division, those joining the primary auricular and ventricular incisions, B C and H G.

Fig. 53.—Lines showing combined primary and secondary incisions of the heart.

septum. On the left side make the incision I H in the left auricle near or below the lowermost pulmonary vein, in the direction of the left ventricular ridge, stopping at the auriculo-ventricular septum. Below the auriculo-ventricular septum make the incision, G F, into the ventricle, along the ventricular ridge to the apex.

Secondary Incisions.

Midway in the incision in the right ventricle make a cut, D L, in the direction of the centre of the pulmonary artery; continue the incision to the bifurcation. In the left ventricle, at the apex,

make the incision F J until the point is reached where the left dog's ear (auricular appendix) overlies upon the left ventricle; then, by introducing the instrument into the aorta, the aortic valves are seen, and the incision J K is made. On the right side make the incision B C by joining the auricular incision, A B, and the ventricular incision, C E. On the right side make incision H G by continuing the auricular incision, A B, to the ventricular incision, G F.

The situation of the mitral and pulmonary valves can readily be remembered by the use of the mnemonic, "*M*artin *L*uther, *T*he *R*eformer"—*M*itral on the *L*eft side; *T*ricuspid on *R*ight side. That there is but one *P*osterior cusp to the *P*ulmonary and one *A*nterior cusp to the *A*orta will readily distinguish this often-forgotten question.

VII. Nares, Larynx, and Trachea.

It is frequently advisable to remove the tongue, œsophagus, trachea, epiglottis, etc., together. For this purpose, in those cases where disfiguration of the body is a matter of no importance, the primary incision over the thorax can be extended up to the symphysis mentis and the part dissected out. There is no necessity for this, however, as, by careful manipulation, the hand can tear the skin away from its attachments by working from beneath, and, the entire part thus loosened, a knife can be introduced into about the centre of the tongue (through the genio-glossus muscle), posterior to the frenum of the tongue, thus leaving the tip *in situ* in case an examination of the mouth be made.

By means of a circular incision, keeping as close as possible to the bony walls of the jaw, carotids and bodies of the vertebræ, pharynx, and larynx, the entire parts may thus be separated, drawn forward, and removed. In the case of a child the entire body can then be eviscerated at once in the following manner: Grasp the trachea and œsophagus and elevate, cutting posteriorly as close as possible to the vertebral column until the diaphragm is reached. This is then cut laterally and posteriorly, the adhesions being again removed with the knife. The rectum is tied with two strings, and cut between the ligatures. Cut loose the crura, and the diaphragm is free. Anything which holds the abdominal organs in place is cut, and the body of the babe is completely eviscerated. In the case of a female you can take the organs of generation (also the bladder) along with the other organs by removing

them in the same manner as in the adult. The advantage of this method is that the organs can be examined most conveniently both anteriorly and posteriorly, and, as all the organs are attached, the same relations are preserved as if they were left in the body. A child disembowelled in this manner can be kept for a long while, especially if the abdominal cavity be packed with a mixture of equal parts of bran and salt. A little white arsenic can be added with good effect to this mixture. The body can then be surrounded with cotton, and a circular bandage applied to the chest and thorax. You can sometimes advise the employment of this method of preserving the body as a means of gaining permission from a parent to hold the autopsy.

The œsophagus and the trachea are preferably opened up posteriorly.

Carefully examine the vocal cords; see if there are any tumors, syphilitic or tubercular ulcerations, inflammation, malformations, foreign bodies, diphtheritic membrane, etc.

VIII. Lungs.

The serous surface is practically not visible unless inflammation has occurred. In order to remove the lungs, they having been thoroughly freed from the pleural adhesions, the upper lobe is grasped and carried away from the median line of the body so as to expose the vessels entering at the hilum; the vessels and bronchi are cut through, cutting from above downward and backward. The left lung should be removed first.

It sometimes happens where the adhesions are very strong that it is necessary to dissect away the ribs along with the lung. The incision in these cases into the lung can frequently be made with advantage by leaving the lung *in situ.*

Examine outer surface for fibrinous exudation, color, minute hemorrhages, fibrinous adhesions, nodules, excessive pigmentation, spots of emphysema, miliary tubercles, consolidated patches, cicatrices, hemorrhagic infarcts, etc.

Place the lung upon a wooden surface and incise with a single stroke from apex to base, commencing at the convexity (laterally) and passing to the entrance of the large vessels. The color of the cut surface is to be determined at once; note the amount of blood and the character of the fluid on squeezing; microscopic examinations of scrapings can be made; look for cavities; the shape of

consolidated areas; determine specific gravity of the consolidated area. A hemorrhagic infarct or portion of apoplectic lung will sink in water as well as the lung of croupous pneumonia. Dissect out the bronchi. Never forget to weigh the organs and to make a written description as soon as they have been thoroughly examined.

In order to make more room for the examination of the abdominal cavity the attachment of the diaphragm to the ribs on the right side can be cut and the liver turned over into the right thoracic cavity. Later on this also gives a favorable opportunity for the examination of the gall-bladder, ducts, and portal vessels.

IX. Spleen.

This is the first organ to be examined in the abdominal region. Introduce the hand below the diaphragm, in the left hypochrondriac region, and grasp the upper surface of the spleen with the hand, allowing the fingers to overlap upon the edge. By the exertion of a small amount of force the spleen can readily be brought to the median line of the body, still attached, however, by the splenic artery. Examine along the course of this vessel for supernumerary spleens. Detach the spleen and remove from the body. Before an incision is made into the organ examine the capsule, which may be thickened; cut transversely from the anterior to the posterior surface; look for Malpighian bodies, trabeculæ of connective tissue, tumors, caseation, miliary tubercles, etc. Note especially the consistence of the spleen and the amount of blood exuded. Infarction of the spleen is quite common, and the amyloid reaction would be more frequently demonstrated if a routine practice of applying Lugol's solution were carried out.

X. Intestines.

Cotton is frequently placed in the rectum by the undertaker or nurse. Do not mistake this for anything abnormal.

Tie two strings around the rectum and cut in between them; then grasp the free end (the one away from the anus) and sever the mesenteric attachment, following up the sigmoid flexure, descending colon, transverse colon, and ascending colon, and taking in about a foot of the ileum. Two circular bands are again applied around the ileum and an incision made between them. The intestines are then removed to the sink and the water allowed to

run through them from the end of the small intestine, the spigot being conveniently introduced into the end of the small intestine and the water turned on. When the water is no longer discolored and the matter that is washed has been carefully examined, the intestine is opened with the enterotome. The rule is to cut along the attachment of the mesentery, this being especially applicable to the small intestine, because the Peyer's patches are situated directly opposite the mesenteric attachment, and the curling of the intestines when opened, in case the mesentery has not been properly cut, is not so marked; the small intestine is then removed up to the duodenum and washed in a similar manner and again opened along the mesenteric attachment.

XI. Semilunar Ganglion and Adrenal.

The semilunar ganglia of the solar plexus are situated in front of the crura of the diaphragm, close to the adrenals, around the cœliac axis, and at the root of the superior mesenteric artery. The adrenals are best removed attached to the kidneys, care being taken not to injure them.

XII. Kidney.

The kidney is easily found by making a nick with a knife in the peritoneum just over the situation of the ureter where it goes over the brim of the pelvis, and following up the ureter, removing the loose tissue with the hand. The kidney may be imbedded in a large amount of fat, or displaced.

The kidney is held in the left hand, the hilum being toward the palm of the hand, and the convexity upward. A brain knife or large cartilage knife is held in the right hand and the kidney bisected, care being taken not to continue the incision so far down as to injure the hand. In order to avoid this the incision may be made to the centre; the kidney then being inverted, the incision is carried upward away from the palm of the hand. In case the kidney is completely cut through, the knife will come out between the thumb and the index finger if the kidney be properly held.

The relation of the pyramids to the cortex is carefully examined (normally it is as 3 to 1). The capsule is then stripped off, taking care to notice if any of the cortical substance be removed at the same time. The external surface of the kidney is examined especially for cysts and stellate veins. Large cysts can readily be seen.

and in opening a cystic kidney be careful that the liquid does not injure the eyes or soil the linen, as when the kidney is opened the liquid in the cyst is under pressure and may squirt several feet.

Tumors of the kidney, especially fibroid, are quite common. In order to determine the consistence of the kidney the cut section is pressed between the thumb and index-finger.

XIII. Organs of Generation.

By means of a circular incision close to the bony parts the organs of generation may be removed entire by cutting all of their attachments without injury to their component parts.

XIV. Stomach.

The stomach is preferably opened along the greater curvature by means of the enterotome, the incision being carried up into the œsophagus about three inches. In case poisoning is suspected, the œsophagus and the portion of the duodenum just below the pylorus should be tied, and the entire organ with its contents removed, placed in a clean jar, sealed, and saved for further examination either by the expert or yourself. The mucous membrane may be washed by means of dipping a sponge in water, holding it about six inches above the stomach, and making gentle traction upon the sponge so as to allow the water to flow over the stomach. The membrane should never be rubbed with the sponge.

XV. Liver.

The liver is measured, weighed, and incisions are made throughout its entire length.

A duct can often be easily followed by making a nick in it, and introducing a piece of broom-whisp or a grooved director in the direction in which you desire to dissect. This is especially useful in the ureters and the ductus choledochus communis. Squeezing the gall-bladder after the duodenum has been laid open will often cause bile to pass out, and the papilla, the ending of the common bile-duct, can thus be demonstrated. In case of suspected stenosis or stoppage of the duct by a gall-stone, it is better not to practise this, as valuable information can frequently be obtained by examination of the mucous membrane of the duct beneath the constriction when it is unstained with bile—which may be caused to be passed by the increased pressure.

XVI. Pancreas.

The pancreas is now to be removed. This is readily accomplished by remembering that it is closely in connection with the central portion of the duodenum. Do not mistake the splenic artery for the duct. Also remember that the pancreas is naturally a hard organ to the touch. Hemorrhages, inflammation, degeneration, stones, tumors, etc., may be found. Fat necrosis should always be thought of, as it is a cause of sudden death, such cases frequently coming under the head of Coroner's cases.

XVII. Aorta.

The aorta is opened throughout its entire extent. Do not mistake the normal opening of the intercostals for anything pathological.

XVIII. Skull.

In order to expose the cranial cavity, an incision is made over the vertex and down to the bone from the base of one mastoid process to the other. If the hair is long it should first be parted in this direction, and the cut, after the first nick in the skin, should always be from within outward. The knife will then cut between the hairs, and not across them as when the cut is made in the opposite direction. The scalp is then reflected backward and forward, a piece of cotton being placed over the eyes and nose in order that they may be protected. It may be necessary to use the knife in loosening the scalp; if so, care should be exercised that it does not slip on the smooth surface of the bone and the operator's hand be injured. The circular or the angular incision through the bone can now be made, the latter being preferable in all private cases, as there is less danger of causing any disfigurement after the head is sewed up.

The Circular Method. The saw cut is made in a line running circularly around the head, starting about half an inch to an inch above the ophryon and ending at the top of the inion. It will thus be seen that the posterior incision is lower than the anterior. This line will cross the temporal muscle about an inch above the external auditory meatus and slightly obliquely. This muscle is then divided in this direction on both sides. The beginner can mark out the line with a lead-pencil. Skulls are of very unequal thickness, those of the colored race being especially

thick. Different portions of the same skull differ markedly, even on opposite sides at corresponding points. The thinnest portion is usually in the squamous portion of the temporal bone. The head is placed on a block, the body being well drawn up toward the head of the table, the left hand is wrapped with a towel and the head steadied while the sawing is being carried on. Unless there is a suspected fracture of the skull, the sawing should be made only to the internal plate, which should next be broken by a chisel and hammer. A bucket is placed on the floor under the head in order to receive the blood and cerebro-spinal fluid; a blunt hook is introduced beneath the frontal bone, and traction is made in the direction of the body. If the dura is adherent, or it the bones have not been well separated, considerable force is necessary, and if used the skull-cap may come away suddenly and injury to the hand of the operator may result. If the dura be very adherent, a spatula or the end of a dissecting knife can be used to separate it from the bone.

The Angular Method. The only difference here is that an angle is made just about the external auditory meatus. The rule for making this angle is to cut through the temporal muscle in both directions so that the knife and saw will escape the ear. In removing the skull-cap it is very necessary that the angles be well sawed through and broken, and that it should be done carefully, as most brains are injured at this point.

The longitudinal sinus is next opened by means of scissors. Do not mistake the Pacchionian granulations which may be present for a new growth such as tubercles. The dura is next cut by means of a blunt-pointed pair of scissors in the line of the original incision. The falx is next divided anteriorly as near to the crista galli as possible, care being taken that the olfactory lobes are not injured. The dura is then thrown backward (posteriorly) over the occipital bone. One end of the frontal lobe is then gently raised, and in case a portion of the dura mater fall over and hide the olfactory bulbs, it can be removed. With the end of a scalpel the olfactory bulb is shelled out from its position on the ethmoid. The same is done on the other side. The ophthalmic artery and the optic nerve are cut as close as possible to their entrance into the optic foramen. Remember now to secure the pituitary body attached to the brain, for later on it will be too late, as the strain that is put on the infundibulum readily causes it to break. This can be readily done by cutting the dura covering-in the sella Turcica

with a sharp knife close to the bone at all points, except posteriorly near the infundibulum, care being taken not to go in too deeply, as otherwise the gland itself may be injured. Scissors are then used to shell out the mass, the remaining portion of the dura is cut with the scissors and the hypophysis cerebri is free, except at its point of attachment to the brain. The internal carotids are then cut as long as possible. This remark is applicable to all the nerves and vessels of the brain. The third, fourth, fifth, and sixth pairs of nerves are cut in their order. The tentorium cerebelli is then cut on each side as close to the temporal bone as possible. The remaining nerves are then divided. The left hand is then placed so as to support the occipital lobes, and a long, slender knife is introduced as close as possible to the cut wall of the foramen magnum, and the cervical portion of the cord is cut in as much of a transverse direction as possible. The vertebrals are then cut, and the fingers of the right hand are used to shell out the cerebellum. The brain is then removed, resting upon the left hand, to a place of safety. A towel rolled up in the form of a turban makes an excellent resting-place for the brain.

Dissection of the Brain.

The brain is first carefully examined on its external surface, taking care not to forget the examination of the fourth ventricle, and the circle of Willis, including the course of the middle cerebral arteries lying in the fissure of Sylvius. This will also give you an opportunity of examining the island of Reil and the retro-insular convolutions. The brain is then put on its basal surface with the frontal and occipital lobe in a direction transverse to the table. This is done for the reason that afterward the incisions are to be made transversely to this line or parallel to the edge of the table. The top of the left hemisphere is grasped by introducing the thumb into the longitudinal fissure, and allowing the fingers to rest upon the convexity. The corpus callosum is then exposed, and the knife is introduced into the anterior genu in the neighborhood of the anterior cornu of the lateral ventricle, and a concave incision is made to the posterior cornu, care being taken not to injure in any way the floor of the lateral ventricle. The amount of fluid and its character are noted. Corpus striatum, optic thalamus, choroid plexus are then examined. The same is done on the right side; the knife is then introduced into the foramen of Monro, and

the anterior fornix is laid forward. If it is desired to examine for the fifth ventricle an incision directly in the median line may be made in the septum lucidum. The body of the fornix is carried back; then examine the corpus fimbriatum, lyra, the anterior, posterior, and middle commissures, corpora quadrigemina, the pineal gland, the commencement of the iter e tertio ad quartrum ventriculum. The crura are then cut across, joining at an angle in the median line. The cerebellum is then removed, and an incision is made in the median line dividing the hemispheres into two. Through each of the four pieces of the cerebrum incisions are made vertically about a quarter of an inch to three-eighths apart, and all pathological changes are carefully noted. The cerebellum is cut in the same manner so as to expose the arbor vitæ. The pons, medulla, and the commencement of the spinal cord may also be cut transversely, but this portion of the brain is preferably hardened in Müller's fluid previous to section, which is best accomplished by the preparation of a microscopic slide.

Section—as modified by Blackburn from the original plan of Meynert—may be made as follows:

The brain is placed with its base upward and the cerebellar end toward the operator. The cerebellum is lifted up and the pia mater is cut through above the corpora quadrigemina, around the crura, and along the inner margins of the temporal lobes until the middle cerebral arteries are reached. The Sylvian fissures are now opened to their entire extent, the opercula are raised, and the insular lobes exposed to their limiting furrows.

The apices of the temporal lobes are now raised, and, with the knife held nearly horizontally, their junction with the base is cut through until the anterior extremities of the descending cornua are opened. The knife is now inserted into the descending horn, and the incision is carried backward as far as the posterior angle of the insula, or even some distance beyond it, severing some of the convolutions at the posterior extremity of the Sylvian fissure.

The next incision is made to separate the basal piece from the posterior extremities of the frontal lobes. It connects the anterior boundaries of the islands and opens the anterior horns of the ventricles. The incision may be a slightly curved, transverse one, connecting the anterior border of the islands; or, by a little care and a double crescentic cut, the exact boundaries of the convolutions may be followed.

The cerebellum is now raised and the knife is entered at the

posterior angle of the island, and the incision is carried along the outer limiting furrow until it meets the cut previously made through the anterior border. Care must be taken to keep the knife in the angle between the roof of the ventricle and the basal ganglia, to avoid injuring the latter. The basal piece is now lifted until the anterior crura of the fornix and the septum lucidum may be severed, and the basal section thereby completed.

The basal piece thus separated includes the island of Reil, the basal ganglia, the crura, pons, medulla, and cerebellum. The brain-mantle includes the convolutions, the corpus callosum, and fornix, and the olfactory tracts.

The cerebellum may be separated from the brain-axis by cutting through its peduncles, and the lobes may be incised as in other methods. The basal ganglia, pons, and medulla are best examined by transverse incisions. The brain-mantle may be incised, if desired by Pitres' method, or hardened without further section.

Virchow's Method.

Virchow's method of dissecting the brain is used by many pathologists. It differs from the first method given, mainly in the section of the hemispheres ; the opening of the ventricles, and the dissection of the cerebellum and basal parts being about the same in both methods.

After opening and examining the ventricles an incision is made in each hemisphere, extending outward and downward from the outer angle of the lateral ventricle to the pia mater of the lower part of the convexity. The portion thus turned outward is now divided into wedge-shaped pieces by incisions made from within outward to the pia mater, leaving the membrane to hold the parts together. The remainder of the dissection is practically the same as that already described.

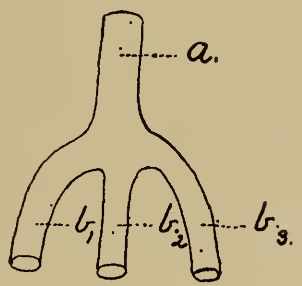
The method employed by Hamilton of injecting the vessels of the brain (*Text-book of Pathology*, vol. i., p. 56) is as follows :

The brain, freed from the dura, but covered by the pia and arachnoid, is next weighed and the vessels at the base at once injected with Müller's fluid, prepared according to the following formula :

	Strong.	Weak.
℞.—Potass. bichrom.	45 parts,	3 per cent.
Sod. sulph.	20 "	1 " "
Water to make	1000 parts,	100 " "

A bulky round earthenware basin with an earthenware lid must be in readiness, as the hardening is to commence at once. Fix a large canula into each of the internal carotids and tie it in with thin waxed twine. Fix another canula into one of the vertebrals, tying the vertebral opposite. Previous to fixing the canulæ into the vessels, attach a piece of strong rubber tubing to each of the former, a foot and a half long. See that this is done *before* tying them into the vessels, as it is difficult to do so afterward. Place the brain, with the three canulæ inserted in its vessels, in the round earthenware basin, and in order to take the weight of the canulæ off the vessels, allow the tubes to hang over the edge. Fix the rubber tubes to the connecting tubes represented in Fig. 54 (b_1, b_2, b_3). The common tube, *a*, is in communication with a tank, which can be elevated or depressed.

FIG. 54.



Into the tank a large quantity of Müller's fluid is poured, and it is elevated to a height of about four feet. The stopcock attached to the tank is gradually turned on, so as to allow the Müller's fluid to percolate slowly through the organ. In order to give the fluid free play, care should be taken to place the canulæ in the natural direction of the vessels and to see that their points are not pressing upon the walls.

The first Müller's fluid which flows out contains blood, and should not be again employed; but the subsequent injections can be made with the same Müller's fluid over and over again. It usually runs through very quickly, and the tank should be replenished at least every day for a week, or oftener if it is found convenient.

The brain should always be freely supported by an excess of Müller's fluid, and there should be an overflow vessel into which the waste may escape. The fluid should be capable of being removed from this vessel without disturbing the brain or the position of the canulæ. If the tank is replenished daily for a week it is usually sufficient; but, if convenient, the injection may

be continued for a fortnight. The longer it is continued the better will the organ be hardened. It may be finally left in the Müller's fluid for from two to three months, or even longer. The organ is not injured by time, and some of the most beautiful brains will be found to be those which have been in the Müller's fluid for five or six months. The hardening process must not be hastened if thorough success is desired.

While hardening it should not be padded to keep it in position. The best means of retaining its proper contour is to leave it in a plentiful excess of the liquid, and its position should be occasionally changed. When cut into after being toughened in this way it presents a truly beautiful appearance.

The following method is, however, more easily carried out, and gives most excellent results:

An open jar, bucket, or wash-basin is one-quarter filled with absorbent cotton, and Müller's fluid is added until the vessel is about one-half filled. The brain, after being removed from the body and weighed, is carefully placed in the centre of the vessel and more fluid is added, until the brain is well covered. The vessel containing the brain is then placed in a refrigerator. If this be done there is no danger that the brain will decompose, even in summer, or if the arteries have not been injected or an incision made into the ventricles. The position of the brain is altered on the next day and the fluid changed. The removal of the fluid can best be accomplished by means of a siphon, the whole of the fluid never being removed.

The fluid is changed again on the third day, then every other day for three successive times, twice a week for the next three weeks, and once a week for the next three weeks.

The brain can then be thoroughly washed and put into alcohol of 80 per cent. strength; or the Müller's fluid can be prepared after the fifth or sixth week with one-fifth alcohol, then with one-quarter, one-third, one-half, and finally three-quarters alcohol, when the brain can be kept for several months until it is transferred to the alcohol of 80 per cent. strength.

Instead of Müller's fluid a $2\frac{1}{2}$ per cent. solution of the bichromate of potassium may be employed.

Giacomini's method is well adapted for the macroscopic study of the brain; but, on account of the employment of the zinc chloride, the tissue is rendered useless for microscopic work. If the specimen be a brain tumor, a small portion of the tumor can be placed

in a hardening fluid for microscopic use, and the process then carried out for the hardening of the specimen.

The brain, in as fresh a state as possible, is put into the liquor zinci chloridi of the U. S. Pharmacopœia. The brain will be found to float at first, and should be turned several times the first day. On the second day the pia and the arachnoid should be removed. They have been employed up to this time in preserving the shape of the brain, but would afterward become firmly adherent to the cortex, and would be removed later on with much difficulty and often with injury to the brain.

The membranes should be removed while the brain is under water or while floating in the fluid.

The brain is left in the fluid about six to ten days. It is then well washed with water and put for ten days or two weeks in 95 per cent. alcohol.

The brain is next removed and placed in glycerin for some ten days more. After this the brain is placed in some absorbent cotton, exposed to the air, in a dark place free from dust.

Any exudation should be carefully removed, and when none appears (which will be in several weeks to as many months) the outside is to be well coated with the best mastic varnish by means of a soft camel's-hair brush.

The brain frequently becomes flattened on the surface upon which it rests. Well packing with absorbent cotton and change of position will frequently prevent the distortion.

Do not forget to label your specimens as soon as removed, nor forget that as the jar is uncovered the fluid will evaporate, and unless renewed the brain may be greatly damaged or even spoiled.

The removal of the brain in a child is much more difficult than in the case of an adult; first, because the brain is much softer, and second, because the dura is adherent to the cranial bones. These two factors add to the difficulty of the task, but there is one that makes it more easy—namely, that the sutures are not ossified together. The brain in a newborn child is so soft that it is almost impossible to take it out without injury. A good method is to lay the child for a short while upon ice upon which some salt has been sprinkled, in order that the brain may be hardened by the cold. I have secured the best results by placing the child in a large basin or tub of water, and the conducting of the final operations here, while the body is held under the water by an assistant. Instead of ordinary water you may use a solution of salt. Add a

half-bucketful of common salt to four or five bucketfuls of water; this makes the solution slightly above the specific gravity of the brain substance, and there is much less danger of injury to the occipital lobes if the brain be taken out in this fluid. You may make exactly the same kind of incision as in the case of the adult. The scalp is much more easily removed than in the adult. The sutures are not joined, and the fontanelles are plainly to be seen. With a small saw, saw through the frontal and occipital bones where ossification has already occurred; the rest of the cutting can usually be done with a pair of scissors or a knife. You then cut on each side of the longitudinal sinus and bend the bones to the side until they break and the brain is exposed, covered by the pia and arachnoid.

When you have sawed the bones, the body should be, preferably, in the salt solution. It is held by your assistant, and you remove the brain as in the adult, first, however, removing the falx cerebri and longitudinal sinus. You next press the brain back and remove, with great care, the frontal lobes, with the olfactory lobes; now cut the optic nerves, remove the pituitary body and the vessels, and expose the base. Cut the nerves and vessels long and sever the spinal cord as low down as possible. When the tentorium cerebelli and falx are cut through, you can push the brain out upon the fluid. Its specific gravity will cause it to float, and if you desire to harden it, a good plan is to place the jar filled with Müller's fluid under the brain. You can get the organ in the hardening fluid without much of the water or salt solution passing out. Afterward change the Müller's solution for a fresh supply.

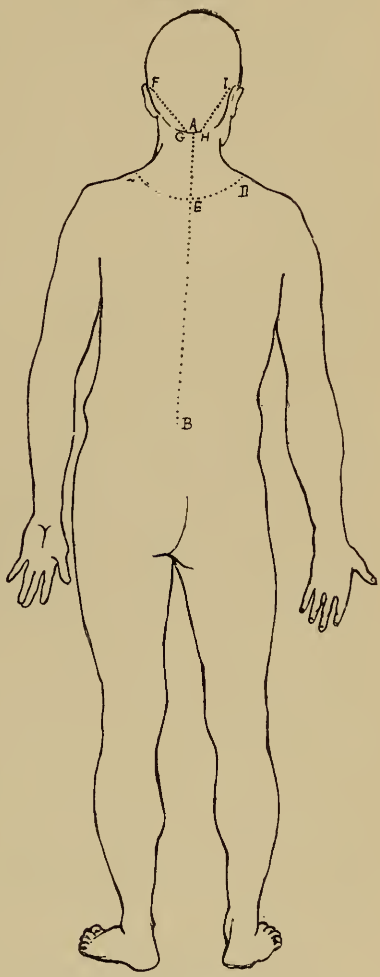
Examination of the Eyes.

For this purpose the orbital plate of the frontal bone is broken through by means of a hammer or chisel, care being taken not to injure the optic nerve at its entrance into the optic foramen, the remaining portion of the eye and the nerve being well protected. The pieces of bone are then removed with the forceps and the cut end of the optic nerve is grasped with the fingers or forceps and the nerve dissected out. The capsule of Tenon and fat are then removed, and an incision is made in the sclerotic, posterior to the conjunctival attachment. This is best done by means of a very sharp knife, as the tissue is extremely tough. A circular incision is then made around the entire eye, and the fundus is exposed. It

is then placed in Müller's fluid for further study. A piece of dark cloth or cotton dipped in ink is then placed in the remaining portion of the eye so that no disfigurement may be noticed. The cavity is then packed with cotton.

In order to expose to view the upper air passages (nasal, pharyngeal, laryngeal, and accessory cavities) Harke[1] (quoted by Hektoen) recommends the following ready procedure:

FIG. 55.



The primary incision, A, B, or the circular incision, C, E, D, the longitudinal incision being from E to B. If it be desired to remove the cord attached to the brain, the posterior flap of the scalp can be divided by a vertical incision, and the wedge-shaped piece, F G, and H I, can be sawed through the bone, so that at their base they will gain entrance to the foramen magnum.

After removing the brain in the ordinary manner, the soft parts are reflected anteriorly down to the root of the nose, posteriorly down below the foramen magnum. Then the floor of the skull is divided in the median line by means of a keyhole saw from the nasal bones in front to the occipital foramen behind, keeping as nearly as possible in the median line. Now the two skull halves are separated by means of a broad chisel and mallet, and as the nasal and pharyngeal cavities come into view, the pieces of mucous membrane may be cut across with the knife or scissors so as to prevent further tearing. With the hammer and the chisel the axis may be divided. The two halves of the skull are still connected by the nasal bones, the maxillary process of the upper jaw and the bony palate; strong traction will separate these bony connections without injury to the soft parts, and the lateral halves of the skull and spine will yield sufficiently to permit inspection of the tract clear down to the vocal cords. Usually the median incision passes a little to one side, but the partitions between the accessory cavities are readily cut away with strong scissors; the maxillary sinuses as well as the frontal, sphenoid and ethmoid cavities, are also easily opened from the median surfaces.

[1] Berliner klin. Wochenschrift, 1892, No. 30.

In order to remove the spinal cord the body is placed on the abdomen, and the head is allowed to hang over the table. With a long sweep of the knife an incision is made from the occipital protuberance to about the fourth lumbar vertebra. Considerable time should then be taken in cleaning the muscle and fascia from the vertebra, as otherwise the teeth of the saw are apt to become clogged with this material. This can be accomplished with a rubbing motion of an old knife or chisel. If the case be one in which no disfigurement at all is permissible, a circular incision, with the radius at the inion, can be made from shoulder to shoulder, and the skin dissected away. This gives abundant room for the introduction of the instruments used for the removal of the cervical vertebræ. Care must be used as to the angle at which the saw is inclined. This should be at thirty degrees from the spine, and about half an inch on each side. There is danger, in case this angle be not adopted, that the saw will either not enter the canal or will enter into the place where the cord lies, and thus injure it. After the sawing has been accomplished in the dorsal region a pair of bone-nippers is used to pry up the portions of vertebra which have been sawed through, and the dura mater is exposed. Then the sawing can be continued in both directions until the entire vertebral canal is open, except that the atlas and axis had better be removed by means of the bone-forceps. The dura and the spinal nerves are then cut below the corda equina, and the anterior and posterior portions of the dura are grasped with the forceps or fingers, and by means of pushing to one side or the other the nerves are cut as they enter into their foramina; the only difficult portion being at the foramen magnum, where the dura can best be cut loose from the bony cranial cavity after the removal of the brain.

After the cord has been removed the dura is to be opened in a longitudinal direction, and transverse sections about an inch apart are to be made through the cord and its membranes. The nerves hold the cord to the dura, and a favorable opportunity is thus given for the examination of the cord with the naked eye or with a hand-lens. The vessel containing the cord should be placed, in summer, on ice and the fluid changed in the same manner as for the brain. The best results are gotten by hanging the cord by means of a string in a long museum jar filled with fluid. Both the brain and cord can, of course, be placed in the same vessel.

To Preserve Urine.

1. Add a few drops of chloroform to the bottle containing the sample of urine, or f℥j of a 5 per cent. alcoholic solution of resorcin.

2. Allow the precipitate to settle to the bottom of the vessel, draw off the supernatant liquid with a pipette, and then add a saturated solution of boric acid.

Either of the above methods will preserve urine for a long time as far as the tube-casts are concerned.

Sputum.

Sputum should be put into a "fired bottle." This is prepared by taking a glass-stoppered bottle and pouring a little alcohol in it; then agitate and ignite. Allow the alcohol to burn out and stopper while hot.

Other organs removed from the body should be first washed in running water until free from blood. They should then be placed in a suitable jar containing equal parts of 95 per cent. alcohol and pure water, care being taken to supply sufficient fluid to well cover the specimen. A piece of cheese-cloth should then be placed on top, so that in case of evaporation the fluid will be supplied to the uncovered portion of the specimens by means of capillary attraction. In case there occurs much cloudiness or the slightest odor, the alcohol should be immediately renewed.

If it is desired to preserve the natural color of the organs the following solution is well adapted for this purpose:

℞—Sod. sulph. Sod. chloride Potass. chlorate	āā	100 parts
Potass. nitrate		10 "
Water to make		1000 "

The fluid should be changed several times, or a saturated solution of boric acid may be employed, to which 50 per cent. glycerin can be added with good results.

Autopsies on the Newborn.

According to Virchow (translated by Smith), the following regulations are in force in Prussia for the guidance of medical

jurists in conducting post-mortem examinations for legal purposes in newborn children :

I. **Determination of Maturity and Period of Development.** In the post-mortem examination of newborn children special attention is to be directed to the following points :

In the first place, the signs indicative of maturity and period of development must be looked for.

These are : The length and weight of the child; the condition of the general integument and of the umbilical cord, the length and state of the hair of the head, the size of the fontanelles, the diameter of the cranium (longitudinal, transverse, and diagonal), the condition of the eyes (membrana pupillaris), the state of the cartilages of the nose and ear, the length and condition of the nails, the transverse diameter of the body at the shoulder and hips ; in male infants, the condition of the scrotum and position of the testicles ; in females, the condition of the external organs of generation.

Finally, we must examine the size of the centre of ossification (if present) in the inferior epiphysis of the femur. For this purpose, the knee-joint must be opened by means of a transverse incision below the patella, the joint fully bent and the patella removed ; thin layers are then to be cut from the cartilaginous end of the femur, until the greatest transverse diameter of the centre of ossification (if present) be reached ; this is to be measured in millimetres.

Should the condition of the fœtus be such as clearly to prove that it was born before the completion of the thirtieth week, it is not necessary to proceed further with the examination, unless the magistrate distinctly requires it.

II. **Determination of the Question whether the Child has Breathed.** If it shall appear that the child has been born after the thirtieth week, the next step is to ascertain whether it has breathed during or after birth. For this purpose the respiration test must be applied, and the proceedings conducted in the following order :

a. Immediately on opening the abdominal cavity the position of the diaphragm is to be ascertained, with reference to the corresponding rib, and, on this account, in newborn children, the abdomen is always to be opened first, and afterward the thorax and cranium.

b. Before opening the thorax a ligature is to be placed around the trachea above the sternum.

c. The thorax is then to be opened, and attention must be paid to the degree of dilatation of the lungs, and their position dependent upon such dilatation, particularly with reference to the pericardium. The color and consistence of the lungs should also be ascertained.

d. The pericardium is then to be opened, and its condition and that of the heart, externally, are to be ascertained.

e. The cavities of the heart are then to be opened, and their contents to be examined, and the condition of the heart in other respects is to be determined.

f. The larynx and that portion of the trachea above the ligature are then to be opened by means of a longitudinal incision, and any contents are to be examined.

g. The trachea is to be divided above the ligature and removed, together with all the organs of the thorax.

h. After removing the thymus gland and the heart, the lungs are to placed in a capacious vessel filled with clean, cold water, in order to test their buoyancy.

i. The lower part of the trachea and its subdivisions are to be laid open and examined, especially with reference to their contents.

j. Incisions are to be made in both lungs, and notice taken whether any crepitant sound be heard, and also with reference to the amount and quality of the blood issuing from these cut surfaces on slight pressure.

k. Incisions are to be made in the lungs below the surface of the water to see whether any air-bubbles rise from the cut surfaces.

l. Both lungs are next to be separated into their lobes, and these are to be divided into several small pieces, the buoyancy of each of which is to be tested.

m. The œsophagus is to be opened and its condition ascertained.

n. Lastly, in cases where it is suspected that air cannot gain access to the lungs, in consequence of the filling up of their cells and passages with morbid products (hepatization) or foreign substances (mucus, meconium), the lung tissue is to be examined with the microscope.

After the examination of the body is completed, all of the blood, fecal matter, etc., should be removed with a sponge from the thoracic and abdominal cavities, and any bleeding vessels tied. The organs can then be returned to the body, and a peck of bran or a roll of absorbent cotton introduced on their top. If any of

the organs have been removed, fill in with old newspapers or towels. If bran is not at hand, a towel or an old sheet can be laid on top of the organs and the body sewed with continuous sutures, starting at the symphysis pubis and sewing from below upward. The stitches should be about three-eighths of an inch from the cut edge and about one-half of an inch apart, the one on the opposite side being not directly opposite, but one-fourth of an inch above and below it. The length of the thread is, roughly, twice the length of the part to be sewed. At the commencement and end tie with a good, strong knot. See that the edges are kept even, so that at the end puckering does not occur. The body is next washed, dressed, and returned to its proper place. If two persons are lifting the body, the lighter weight is obtained by holding the feet.

Urine or aromatic spirit of ammonia will best take off the odor from your hands. This odor is usually gotten from opening the intestines. Ammonia (also the aromatic spirit) will remove iodine stains; a weak solution of the hypobromite solution will remove carbo-fuchsin and other anilin stains from the hands.

It is well to remember—

That in warm weather the intestines are especially liable to undergo rapid decomposition when exposed to the air;

That a railway train or cart may pass over the body and there be no abrasion in the skin more than a brush burn;

That the color of organs is frequently changed when exposed to the air by the oxidation of the hæmoglobin. Also that the sulphide of iron frequently discolors organs after death, due to the sulphuretted hydrogen during decomposition precipitating the iron of the hæmoglobin;

That many signs of inflammation, especially of the mucous membrane, disappear after death. Remember that red flannel often colors the skin red;

That blood makes a good glue for affixing labels, and the blood of a person dying from hydrocyanic-acid poisoning makes a most excellent red ink which will keep for years without the addition of any preservative fluid;

And lastly, be honest. Everyone diagnoses lesions during life which are not found at the post-mortem.

PART III.

SPECIAL PATHOLOGY.

There is no work in the English language that can be so thoroughly recommended for the study of the lesions in special pathological anatomy as that of Osler's *Text-book of Medicine.*

The number of lesions that can affect any individual part is necessarily limited. The following plan will aid one in correctly diagnosing the lesions of any organ:

Consider—

1. The normal anatomy and histology of the part.
2. Malformations, congenital and acquired.
3. Parenchymatous changes.
4. Interstitial changes.
5. Blood changes.
6. Inflammation.
7. Infectious diseases.
8. Tumors and parasites.
9. Action of poisons.
10. Post-mortem changes.
11. Microscopic examination.
12. Bacteriological examination.

If you are given a specimen to diagnose, try to find out all you can about the person from whom it was removed, the condition of the various parts, and the reason for its removal. Failing in this, determine whether it is an organ, a tumor, or a tumor in an organ. If an organ, run over in your mind the lesions which are alone possible to be found in such an organ (such a list, for example, as is given under the heading of the Lung); *e. g.*, it would be absurd to think of a croupous pneumonia in a piece of liver, yet the action of the toxine elaborated by or through the pneumococcus in producing a parenchymatous degeneration should be considered if

the lungs show croupous pneumonia. Then exclude those conditions which are inconsistent with the appearance of the specimen, *e. g.*, if the intestines do not show anything wrong with the solitary follicles, typhoid fever need not be considered as being capable of demonstration from such a specimen. Next group together those lesions which the specimen might illustrate, and by exclusion of what it is not, rather than by what it really is, you will often be able to make a diagnosis. Naming a lesion which looks like the specimen is by no means so bad as not being able to even mention what the specimen really is.

A lesion in one part of the body will often suggest an examination for another lesion in another part of the body, *e. g.*, if you find ulcerative endocarditis you will carefully examine the lungs, spleen, kidneys, and so forth, for hemorrhagic infarcts. There is often an association of lesions, *e. g.*, in cerebral hemorrhage look for miliary aneurisms and atheroma of the vessels. It should constantly be borne in mind that a combination of lesions will often deceive you, *e. g.*, acute yellow atrophy of the liver in a case preceded by pseudo-hypertrophic cirrhosis.

There is no question so hard to answer as, How do you know that a specimen is such or such a thing? Different persons will arrive at the same conclusion by different methods of investigation. Things which we think we know to-day may be shown to be false to-morrow. Tests which are at one time supposed to be infallible are seen to have exceptions which practically invalidate the tests.

Brain.

Gower's table of intra-cranial growths arranged in the order of their frequency:

1. Diathetic: tubercular and syphilitic.
2. Sarcomatous: glioma, sarcoma, myxo-sarcoma.
3. Carcinoma.
4. Osteo-fibroid: fibroma, osteoma, osteo-fibroma.
5. Miscellaneous: cholesteatoma, lipoma, vascular or erectile tumors, psammoma, neuroma.
6. Parasitic: echinococcus and cysticercus.

Exhibits.

1. Glioma of the cerebellum.
2. Aneurism of the basilar artery.

3. Rupture of a bloodvessel into the internal capsule.
4. Extra-dural hemorrhage.
5. Osteophyte of the falx cerebri.
6. Abscess of the brain.
7. Softening of the brain.
8. Miliary aneurisms of the arteries of the brain.
9. Atheroma of the circle of Willis.
10. The brain of an idiot.
11. Hydrocephalus.

Out of 646 cases collected by Gowers there were twice as many tumors of the brain in the male as in the female. The reason for this is not clear. There is no case yet recorded of a tumor appearing in a child before the age of six months. Tubercular tumors are especially liable to occur in children between the tenth and twentieth years. Tumors are less apt to appear in old age than in middle life. They are most common between the twentieth and fortieth years. Syphilitic tumors may come on in twelve

Fig. 56.

Hemorrhagic tumor of the pituitary body.
(From a patient of Anders in the Philadelphia Hospital. Post-mortem by the author. *Journal of Nervous and Mental Disease.*)

months after the initial lesion, or there may be as long time elapsing as fifteen years after the initial lesion. The usual time is from five to eight years. There is no doubt that the number of syphilitic tumors reported is entirely too small, because many may have entirely disappeared under appropriate treatment or are not correctly diagnosed. Tubercular and syphilitic tumors con-

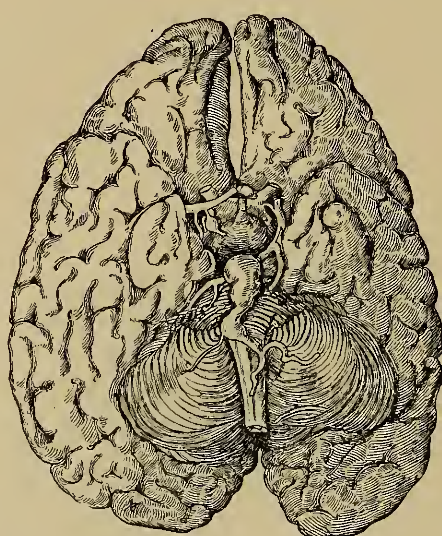
stitute the largest proportion of brain tumors found on the post-mortem table—75 per cent. of all tumors belong here.

Leaving syphilitic tumors out of the list, one-half of the remainder are tubercular and one-third of the other half sarcomatous.

The cerebellum is much smaller in actual amount of brain tissue than the cerebrum, the tumors of the former being proportionately greater than those of the cerebrum.

Tubercular tumors possess certain characteristics peculiar to the brain. A tumor in the brain may grow to the size of a hen's egg and be solitary or multiple. It may become encapsulated by being surrounded by fibrous tissue, and afterward become infiltrated with the salts of lime. It grows by the coalescence of smaller tubercular nodules.

FIG. 57.



Aneurism of the basilar artery.
(*Trans. of the Path. Soc. of Phila.*, vol. xv.)

Abscess of the brain may occur at any age, at any time of the year, and in either sex; but it is more common in the male than in the female, the proportion being as 3 to 1.

The cause of abscess is usually one or other of three kinds:

First. Traumatic. The largest class with which we have to deal.

Second. Access of micro-organisms through the channels which have more or less communication with the brain, such as the middle ear, necrosis of temporal bone, or through the nose. There was a case lately at the University Hospital in which abscess of

the brain followed an operation upon the nose. Several cases have been caused by the "oïdium albicans" of thrush.

Third. Access of micro-organisms by the blood. Cases comparatively few.

Abscess may be single or multiple. May communicate with the membranes or be entirely hidden within the brain substance. One-half or even two-thirds of the brain may be involved. They can often be diagnosed and localized (even the small ones) with comparative accuracy.

Cerebral Hemorrhage. Familiarity with the brain and the distribution of its bloodvessels will indicate where hemorrhage is most likely to occur. Most damage is done by the rupture of arteries situated in the internal capsule. Apoplexy is the popular term given to cerebral hemorrhage.

Hemorrhages may be divided into meningeal and cerebral; the former meaning hemorrhage in connection with the membranes, and the latter restricted to hemorrhage in the brain substance. An extra-dural hemorrhage is very apt to be associated with fracture of the skull.

It is not often that veins will rupture in health; in suffocation veins are more likely to rupture than arteries. French pathologists find that minute aneurisms of the arteries precede hemorrhages, and the minute hemorrhages are preceded by degeneration of the vessel walls and a giving way of the muscular coats.

Hemorrhages may occur at all periods of life. They are more common in temperate climates than in warmer ones, and in winter than in summer, and in the male than in the female. Cases are on record in which entire families have been swept away by apoplectic attacks. The chief seat of the lesion is in the internal capsule. The opposite side of the body is affected.

Spinal Cord.

Exhibits.

1. Normal cord imbedded in celloidin and impregnated with a neutral copper acetate solution as practised in Weigert's method.
2. Syringomyelia.
3. Locomotor ataxia.
4. Disseminated sclerosis.
5. Myelitis.

The descending tracts of the cord are the cross pyramidal tract, the direct pyramidal tract, the antero-lateral tract, and the comma-shaped tract.

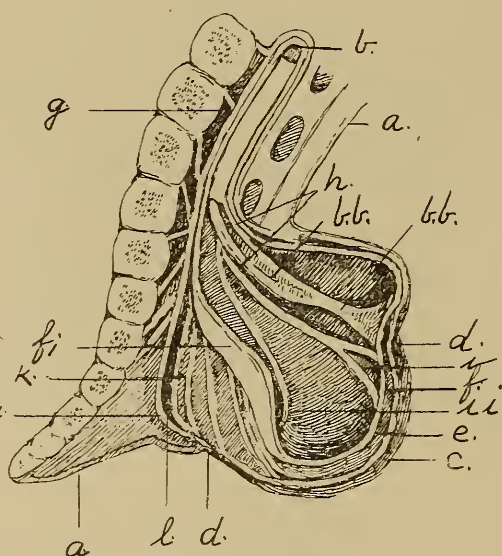
The ascending tracts are the direct cerebellar tract, the postero-median tract, the postero-internal column or the column of Goll, the postero-external tract or the column of Burdach, the ascending antero-lateral tract or Gowers' tract, the posterior zone or Lissauer's tract.

Spina Bifida.

The term spina bifida is applied to a congenital defect in the union of the laminæ of one or more vertebræ, associated with malformation of the spinal cord or its membranes.

The spinal cord and a large part of the brain are formed by the dorsal coalescence of the medullary folds. The fusion of these folds commences in the thoracic and extends into the cephalic and caudal regions. For a short time after coalescence the embryonic cord and superficial epiblast remain in contact. Gradually they

FIG. 58.



Case of spina bifida. The letters refer to the various anatomical parts

become separated by the intrusion of connective tissue, some of which chondrifies and afterward ossifies to form vertebræ and inter-vertebral disks. In the early stages the cord has a longitudinal extent equal to that of the notochord, and this equality is maintained for some time after the closure of the medullary groove. Subsequently the vertebral column grows at a greater rate than the nerve-tube; the result is that at birth the medullary cone at the

end of the cord is opposite the upper border of the second lumbar vertebra. [From *Tumors: Innocent and Malignant*, by J. Bland Sutton.]

Heart.

Pericarditis. An inflammation of the sac or serous covering of the heart. Inflammations of pericardium occur exactly as do inflammations of the pleuræ or peritoneum. There is an outpouring of serum with a large amount of clear fluid. You have to distinguish whether it is inflammatory in character or merely a serous exudate. Usually you soon have the formation of flakes of fibrin, which can be readily recognized by the naked eye. You may have a combination of the **serous** and **fibrinous** variety, or an **organized** mass, or an **infiltration with salts of lime**, or a variety in which **pus** is formed. There is a variety in which **tubercular** processes are set up.

Exhibits.

1. Cloudy swelling.
2. Fatty infiltration.
3. Fatty degeneration.
4. Brown atrophy.
5. Acute myocarditis.
6. Chronic myocarditis.
7. Aneurism of the heart.
8. Cardio-myomalacia.

Hypertrophy and Dilatation.

Acute endocarditis, chronic endocarditis, ulcerative endocarditis. New growths: Tubercle, syphilitic gummata, secondary cancers and sarcomas (rarely primary), fibroma, myoma, lipoma, and cysts of the echinococcus and cysticercus.

Arteries.

1. Acute arteritis.
2. Chronic arteritis and atheroma.
3. Endarteritis obliterans.
4. Aneurisms.

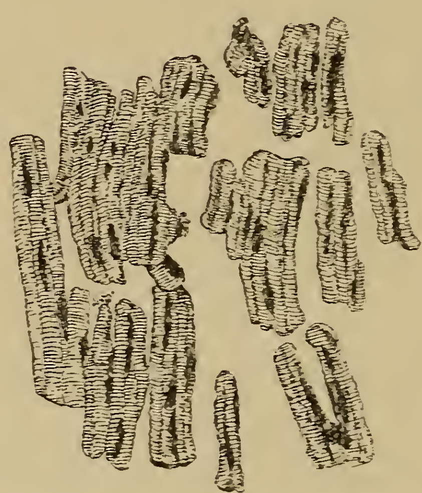
Remarks.

Cloudy swelling of heart is due to an inflammation which has lasted only a short time, or it is the precursor of fatty degeneration. One of the causes is high fever, as in scarlet fever, typhoid fever, or septicæmia. Macroscopical examination shows the heart in this condition to be friable, *i. e.*, easily broken with fingers, and it looks as though it had been in boiling water. Under the microscope, the normal striation of the heart-muscle has been lost, and you seem to be looking at the specimen through ground-glass, or it seems as if the specimen had been dusted with fine dust. Acetic acid will clear away the cloudy condition and cause the normal striations and the nuclei to reappear.

Fatty infiltration to a slight degree is normal. To a larger degree it is found in persons who are constitutionally inclined to obesity. Starts from the outside.

Fatty degeneration of the heart follows hypertrophy, fatty infiltration, interference with oxygenization, etc. Starts from the inside.

FIG. 59.



Brown atrophy of the heart. × 400. (WOODHEAD.)

Muscle fibres broken up into short segments. Mounted unstained in Farrant's solution. The pigment is collected around the nucleus. In this condition the transverse striation is very plainly marked.

Brown atrophy. A decrease in the size of the cells, or a diminution of their number. The heart is pigmented and smaller than normal, and there is a tortuous and shrunken appearance of the coronary arteries.

Myocarditis. Inflammation of the muscle of the heart. Acute or chronic. Occurs usually by means of an extension from an

inflamed neighboring part, as in pericarditis or endocarditis. In the chronic cases there is a proliferation of the connective tissue septa which dip down between the muscular fibres.

FIG. 60.

Fatty degeneration of the muscle of the heart. × 350. (ZIEGLER.)

Endocarditis. Inflammation of the endocardium, chiefly situated in the valves. The great majority of cases are due to the presence of micro-organisms.

Tumors of the heart are of rather rare occurrence. There may be tubercle, syphilitic gummata exactly similar to gummata in other parts of the body, myomata, which are usually congenital, secondary carcinomata and sarcomata, fibromata, lipomata, and the cysts of the echinococcus and cysticercus.

Arteries stand a great deal of inflammation, particularly in tuberculosis. It has been well said that a person is as old as his arteries.

Endarteritis obliterans occurs principally in syphilis.

Aneurisms of the heart are rather frequent. Many cases are on record. They are usually preceded by degeneration of the heart-muscle.

Kidneys.

Exhibits.

1. Stone in the pelvis of the kidney.
2. Horse-shoe kidney.
3. Picture of bilateral double ureters.
4. Acute parenchymatous nephritis.
5. Chronic parenchymatous nephritis.
6. Chronic interstitial nephritis.
7. Amyloid kidney.
8. Hæmatoma of the kidney.
9. Cysts of the kidney.
10. Lobulated kidney of a child.

A great deal of confusion is caused in the description of pathological lesions of the kidney on account of the multiplicity of terms employed. All lesions may be classified under the structures affected in three divisions:

I. Epithelial (parenchymatous).
II. Connective tissue (interstitial).
III. Vessels (vascular).

Bear in mind that there is practically no such thing as a pure form of nephritis, and that the condition which predominates gives the name to its lesion. For example, when we speak of parenchymatous nephritis we do not mean that the epithelial cells alone are affected without any involvement of the connective tissue. We may also describe a kidney as one of chronic parenchymatous nephritis in which interstitial changes are beginning to predominate. Any portion of the uriniferous tract may be affected primarily, hence the names glomerulo-nephritis, etc. Cysts, the adhesions of the parenchyma to the capsule and increased consistence are the great features of connective tissue changes. The yellowing of the cortex, due to fatty degeneration of the epithelial cells, is the striking feature of a parenchymatous nephritis, along with an obliteration of the smaller bloodvessels, and the primary increase in the relation of the cortex to the pyramids.

Fatty and Contracted Kidney.	*Red Granular Kidney.*
Contraction of kidney, secondary.	Contraction of kidney, primary.
Size seldom below normal.	Size, below normal; often reduced to one-half or one-fourth.
Capsule adherent only in places, seldom thickened. Surface lobulated, often smooth. Color, pale, mottled or yellow.	Capsule adherent, thickened. Surface granular, rough. Color, red or grayish red.
Cysts usually large, and seldom numerous. Pelvis rarely dilated.	Cysts usually small-sized and numerous. Pelvis often dilated.
Arterial changes are rare, or not pronounced.	Arterial changes (endarteritis, or peri-arteritis) almost invariably present.
Cortex often normal in size. Atrophy very late.	Cortex always much atrophied.
Renal epithelium much swollen, desquamating freely, often in a state of fatty degeneration, but cells always visible. Compound granule cells.	Renal epithelium never desquamating, though it may undergo fatty degeneration (necrosis), and become diminished in size and partly lost.

Fatty and Contracted Kidney.	*Red Granular Kidney.*
Tube-casts, epithelial, dark granular, and containing compound granule cells, and later fat-globules.	Tube-casts, hyaline, pale, granular, and waxy, but never containing epithelial cells.

[From *Philadelphia Hospital Reports*, vol. i.; by Dr. FORMAD.]

Diseases of the Genito-Urinary Tract.

Malformations and Deformities.

Lesions of the kidney affect either the parenchyma or the connective tissue. Usually both are concerned in the process, and there

FIG. 61.

Bilateral complete double ureters.

(From a patient of Professor HIRST'S, in the University Hospital. From a photograph by Dr. WALLACE. Post-mortem by the author.)

is therefore no such thing as a pure parenchymatous nephritis or a pure interstitial nephritis. Different names are often given to the inflammatory process according to the particular portion of the tubules effected. In interstitial nephritis cysts are frequently seen. A great many are formed by occlusion of the urinary tubules; such cysts are usually small, because the pressure upon the cyst will before long be equal to that of the blood, and consequently the cyst-formation stops. Perhaps several will run together, and in this way larger ones may be produced. These cysts are called

primary, and they contain different materials in different cases. This may be:

1. A gelatinous substance.
2. True urine.
3. Blood serum.
4. Blood, making the so-called blood-cyst, or, if larger, the hæmatoma.
5. A colloid or mucoid material.
6. A cheesy material resulting from degeneration of the epithelium.

Cysts may also be **secondary**. Such are often seen at birth, and may occur in the situation of the normal lobulation of this

Fig. 62.

Hæmatoma of the kidney.
Specimen in the Museum of Morbid Anatomy, University of Pennsylvania.

organ in intra-uterine life. They may also follow gummata. A specimen shown has two large cysts. One is full of a clear fluid, which now is probably alcohol, as the specimen has stood in this fluid for some time; below this is a larger cyst filled with a different fluid, probably resulting from degeneration. Such a cyst may have a stone as its starting-point. Another specimen shown has a smaller cyst, resulting probably from interstitial nephritis.

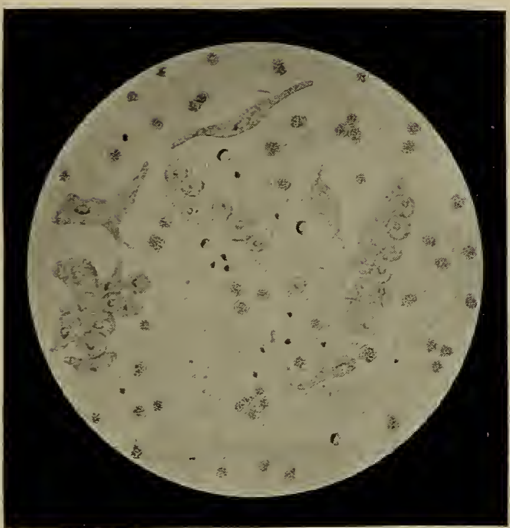
Forms of Renal Calculi (after Woodhead).

1. Reddish or brownish-yellow uric acid in the form of gravel, or rounded, smooth masses the size of a pea or larger.
2. Calculi filling the pelvis and calyces of the kidney, irregular and branching, with a somewhat rough surface, and composed of phosphates and uric acid or urates.

A

B

C



D

A. Leucin balls, and tyrosin sheaves and rosettes.

B. Spermatorrhœa. Morning urine. Spermatozoa, lymph bodies, and spermatic crystals are seen.

C. Acute parenchymatous nephritis, of several weeks' standing. Hyaline, epithelial, and granular casts, with epithelial-, blood-, and pus-cells.

D. Chronic parenchymatous nephritis, with fat in the urine. The casts here are of a markedly degenerative variety, and various forms of the products of fatty degeneration are seen, as margaric acid crystals and cholesterin.

(From *Atlas der Mikroskopie am Krankenbette*, by Dr. A. Peyer.)

3. Oxalate of lime calculi; small, smooth, or mulberry masses, dark-gray or purple in color, and extremely hard.

4. Carbonate of lime calculi are found in the kidneys of old people. When pure they are usually yellow and hard.

5. Phosphate of lime calculi.

6. Triple phosphate of ammonium and magnesium may be found deposited on any of the various other forms of calculi or on an inflamed surface, especially where there is decomposition of the urine.

7. Cystin calculi are rarely met with.

8. Xanthine calculi.

9. Bile-pigment calculi are sometimes met with in people suffering from icterus, especially in the case of newborn children.

It is rarely that we find these stones made up entirely of one substance; usually the centre is made up of one kind of material, and upon this nidus there is the successive deposition of other salts. Sometimes a foreign body, as a hair-pin, may form in the bladder the nidus, and very frequently the centre of a stone is made up of uric acid. Stones in the kidney and bladder occur more frequently in localities where the water contains an excess of inorganic salts. Here the calcium carbonate calculi are most common on account of the limestone found in this section.

The size of calculi depends entirely upon the case; no rules can be given. They may be single or multiple. If multiple, they are apt to be small; if single, large. There may be a dozen or more. They are of all shapes; those in the pelvis are usually very irregular in outline. An irregular stone in the pelvis of the kidney of a man aged ninety is shown in the demonstration. You can very readily understand how such a stone could give rise to the great pain which accompanies such cases, and which frequently leads the surgeon to operate. Another specimen shown is composed of a basis of oxalate of calcium, about which the triple phosphates have accumulated. Such stones are very irregular in shape. The majority of kidney stones pass into the bladder, where they may afterward become agglutinated. Other varieties form here in the first place.

Calculi form in other cavities besides that of the kidney and in the urinary bladder. They are sometimes found in the duct of Stenson, which comes from the salivary gland, and in the pancreatic duct. Occasionally they are found in the prostate, especially

in old age. Rarely they are found in the prepuce; but other so-called stones in this situation are usually calcified smegma.

Urinary calculi are most frequent in the young, 60 per cent. occurring before the age of twenty-six. They are relatively more common after sixty.

Diseases of the Ureters.

Malformations. We not uncommonly meet with the existence of **double ureters.** Usually it will be found that in a case of this kind the ureters join before entering the bladder, and this usually happens at the middle third or below it. It is very easy to overlook this fact, and a careless observer would say they were separate throughout their course. In order to aid the dissection of the ureters you may make use of the following plan: Take a piece of grass from a broom, make a small incision into the tube, well up where you can easily see it, and through this pass the grass into the bladder. You can now with ease dissect up the tube upon this guide. Sometimes the double ureters remain separate and empty into the bladder without joining. In this case you will be able to detect four **papillæ** upon the mucous membrane of the bladder. Such a case occurred at the University Hospital some time ago, and you can see the condition in Fig. 61.

The ureters are very often occluded from a number of causes, such as tuberculosis and syphilis, which cause ulceration and subsequent cicatrization. As a result of the occlusion, the ureters above the seat of obstruction will become greatly dilated, sometimes four, five, or six times the normal size.

Diseases of the Bladder.

Fungoid growths are in this situation quite common, especially the papilloma. They may break down and ulcerate.

Cystitis. This is a very common condition, and in the chronic forms leads to great thickening of the bladder wall. The appearance of the interior in the chronic cases is not unlike that of the left ventricle. The urine finds pockets in the thickened mucous membrane, and these pockets often lodge stones; they may extend for an inch or more into the bladder walls. You can very readily understand that a stone in the bladder may be detected with a sound one day and the next become buried in one of these pockets, and the surgeon be unable to find it upon

the day of operation. I recall a case of this character at the University Hospital. All the symptoms of stone were found the day before operation, but when the patient came before the class none could be detected by the sound. The operation was continued, however, and a large calculus taken out. There are a great many diseases of this tract which belong especially to the genito-urinary surgeon. You, of course, know how common is stricture, and that an enlarged prostate is of very frequent occurrence in old people. These parts are very often malformed. Hypospadia and epispadia are often seen, and result from a failure in union in early life. The scrotum is sometimes divided, and this may lead to a mistake in sex. I remember a case of this kind where the true sex was not discovered until the sixteenth year.

The penis may be malformed and perhaps hid in the scrotum; such cases promise much by early operation, for when the organ is released it generally grows afterward to its normal size.

Diseases of the Uterus and Tubes.

You have so often heard of these from the chair of Gynecology that it is only necessary to review a few of the most important:

Malformations in size are not uncommon. Here is a specimen showing a uterus so small that it can hardly be seen. You will notice that the tubes and ovaries are of about normal size. Such a condition is a frequent cause of sterility.

Tumors are very common. It is rare for a woman, especially a colored one, to go through life without one; they are usually fibroids in the uterus.

Cancers may occur at any part of the tract.

Extra-uterine Pregnancy.

There can be no doubt of the great frequency of this condition. It is still a cause of many deaths, but of late years the gynecologists have done much to diminish the number of cases going on to a fatal termination. Dr. Formad used to say that some years ago he would have as many as fifteen cases come under his care in the course of a year, while of late this number was reduced by 50 or 60 per cent. Women do not go about now as they did some years ago, with an abdomen filled with blood from a ruptured extra-

uterine pregnancy, and so they no longer come under the observation of the Coroner's physician. The condition is diagnosed early usually, and operation will very often save the life of the patient. An interesting case of extra-uterine pregnancy that came under my observation last year very well shows the benefit that could have resulted from an operation. Here the pregnancy had occurred the summer before and had progressed until the gestation sac had become as large as a small fist; it was upon the right side. The sac was firmly attached to the caput coli, and in the umbilical region a very interesting state of affairs was found. Here it was noticed that two coils of intestine were connected by a narrow band of fibrous material, which resembled very much a carpet thread. Underneath this band was another loop of intestine which had become twisted upon itself over the band, and a volvulus was produced. You can very readily see that an operation to relieve this condition would be an easy one; it would only have been necessary to cut this narrow band. As it was, it produced the death of the patient.

An extra-uterine pregnancy is well shown in this specimen. You will notice that the small sac is filled with blood; this is the usual condition; you will notice upon the post-mortem table it is often impossible to find the embryo after rupture has taken place. The amount of blood lost in rupture is sometimes very great, and perhaps no condition produces as much shock as does the rupture of an extra-uterine gestation sac. The whole subject of extra-uterine pregnancy is shrouded in mystery. The cause is still unknown. It is at present not known if the ovum is impregnated within the uterus or while yet in the tube Lawson Tait is of the opinion that extra-uterine pregnancy occurs because there has been a previous salpingitis which has denuded the tube of its ciliated epithelium, and there is, consequently, obstruction to the passage of the ovum into the uterus. This is probably not the case, because in many cases the epithelium is normal. Sutton believes that the tube is closed, but that cilia are still present and normal.

A peculiar condition is that known as the blighted ovum or the apoplectic ovum. Here a mass of clotted blood containing a cyst, the whole being about the size of an English walnut, is passed from the uterus. This usually occurs about the second or third month and frequently produces quite extensive hemorrhage.

A small embryo may, instead of passing downward into the uterus, pass into the abdominal cavity through the abdominal

ostium, and thus may lead to peritonitis. If such a condition does not occur before the fifth or sixth week it probably cannot take place, for at this time the ostium becomes closed. It is an interesting fact that extra-uterine pregnancy is not reported in the lower animals; you should remember this, and if you meet with a case it will be well worth recording.

Respiratory Tract.

1. Nose.
    - Larynx.
        - Trachea.
            - Bronchi.

2. Lungs.
    - Abscess.
    - Anthracosis.
    - Apoplexy.
    - Atelectasis.
    - Bronchiectasis.
    - Bronchitis.
        - Acute.
        - Chronic.
        - Capillary.
    - Brown induration.
    - Cirrhosis.
    - Collapse of.
    - Congestion of.
    - Cysts.
    - Emphysema of.
    - Fat embolism.
    - Gangrene.
    - Hemorrhage.
    - Inflammations of.
    - Œdema.
    - Parasites.
    - Phthisis.
        - Acute.
        - Chronic.
    - Pleurisy.
    - Pneumonia.
        - Fibrinous-croupous.
        - Lobar.
        - Catarrhal or lobular.
        - Desquamative.
        - Caseous.
        - Purulent.
        - Interstitial.
    - Syphilis.
        - Tumors.
            - Primary.
            - Secondary.

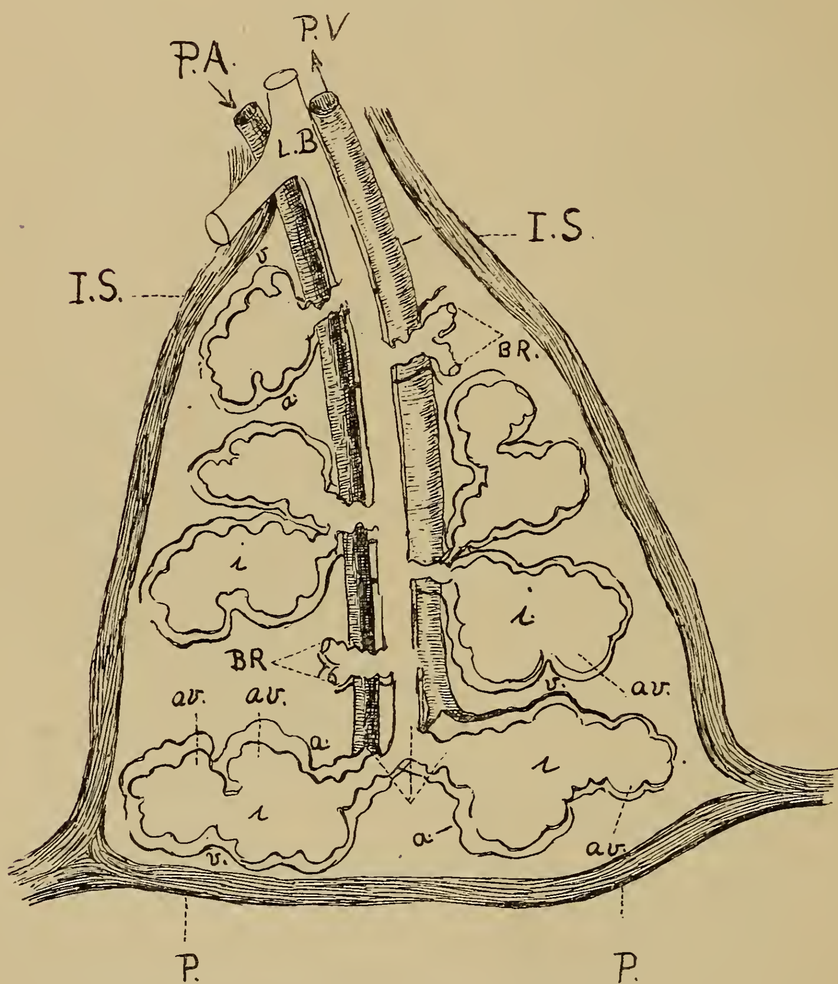
Exhibits.

1. Tubercular and syphilitic ulcerations of the larynx.
2. Phthisis (with slide, showing tubercle bacilli).
3. Anthracosis.

4. Croupous pneumonia (with slide).
5. Secondary cancer of the lung.
6. Calcareous tuberculous nodules in the lung.
7. Emphysema (with slide).
8. Atelectasis (with slide).
9. Hemorrhagic infarct.

In reviewing your work for the examinations you will find that a very excellent plan is to take some medical book, such as Prof.

FIG. 63.



Scheme of a lung lobule.

P A and P V, pulmonary artery and vein; BR, bronchiole; I, infundibulum; a v, air-vesicles; I S, inter-lobular septum; P P, pleura; L B, lobular bronchus. (LANDOIS and STIRLING.)

Ashhurst's *Surgery*, and, turning to the index, to run over the contents in alphabetical order. Pass each word before your mind,

and, if you are not familiar with its meaning, turn to the text and review it.

The Nose. Malformations of this organ are quite common. Perhaps the most frequent is a deviation of the septum to one side or the other. In the condition known as cyclops, in which there is only one eye, the nose may be absent, or, if present, exist as a snout. In this condition there has been a failure to develop or an improper fusion of the embryonal layers. Quite frequently you will see persons upon the street with the nose much enlarged and with dilated vessels. This may be due to a congenital dilatation of the vessels—an angiomatous condition—but is more frequently the result of excesses, especially of alcohol, and is known as acne rosacea or rhinophyma. The nasal chambers are divided into the olfactory and respiratory portions; each of these has its peculiar epithelial lining. The nasal mucous membrane is subject to all the disorders seen in other mucous surfaces. It may be the starting-point for diphtheria or scarlet fever, just as the exposed mucous membrane in the case of extrophy of the bladder may be. Do not forget that tuberculosis may start here primarily, and the lesions of this membrane in such cases are very often overlooked. Many of the cases of chronic nasal discharge will show the bacillus in the material from the nose if such be examined. At the post-mortem this cavity can be exposed posteriorly by cutting away the sphenoid bone in a triangular manner. **Tumors** in this situation are common, and a great deal of attention has been paid to this subject of late. It is a peculiar fact that hypertrophies and tumors of the nasal cavities sometimes produce serious reflex symptoms. Many interesting papers have been written upon this matter, especially abroad, where reports have been published of a large number of such cases occurring among school-children. For example, it was found that a child might by reason of a nasal growth become, as indicated by a photograph, really a high-class idiot. After removal of such a tumor this child would rapidly reach a condition in which the symptoms of idiocy were no longer to be noticed. In some schools the children have been examined, and sometimes, after removal of a nasal tumor, a child which before had stood at the bottom of the class would progress very rapidly toward the top. The reason of this reflex disturbance is not known. It has been thought that such growths may prevent the normal interchange of gases supposed to exist between the frontal sinus and the nose. Whatever

the cause may be, there is no doubt that most remarkable reflex disturbances may occur, and even epilepsy and asthma are produced by these nasal growths.

Polyps are quite common. They are often other growths that have undergone myxomatous degeneration, but occasionally are myxomatous from the start. Fig. 21 shows a growth protruding from the nose; it is supposed to be taken from a nun's face—for these growths usually only reach such a large size in persons who live in convents or where the surgeon is not allowed to operate. Picking of the nose is a frequent cause for the formation of these growths. These polyps are often very vascular, and on removal an extensive hemorrhage is not infrequently produced, and in consequence has been followed by death.

A purulent discharge from the nose is caused by a great many diseases. This is a prominent symptom in grippe, and follows a number of the infectious diseases. Gumma and the lesions of tuberculosis may occur in this situation, and, as you know, glanders is common in the horse. As a rare infection of the nasal mucous membrane, I may mention that of the common gad-fly, or Gastrophilus equi. Sometimes this fly, which you may have seen while driving through the woods, will lay its eggs in the nose, and from these numerous larvæ will be hatched, which burrow into the tissue. Death is rapid and most horrible.

Diphtheria, Syphilis, and Tuberculosis.

Diphtheria of the larynx was formerly thought to be different from the process occurring in the pharynx; but we now know that they are both caused by the same bacillus. Diphtheria in the larynx usually results from extension from the pharynx, and differs from the pharyngeal form in being more superficial. This occurs because the structures here are more dense and hard, while in the pharynx there is much lymphoid tissue. Fig. 22 shows the condition very well. You will notice this mass of false membrane which extends far down into the trachea. Such a growth of false membrane would offer considerable obstruction to the passage of air; portions may be taken into the smaller tubes and set up a catarrhal pneumonia. You may have the formation of a false membrane from other causes besides diphtheria; it may be caused by the inhalation of hot air or steam, and the membrane thus

formed may so closely resemble that of diphtheria that you cannot tell them apart by a gross examination. It is sometimes difficult to tell syphilis from tuberculosis as it occurs in the larynx; yet it is often quite important to be able to differentiate between them. If there is any rule for this, it is that the lesions of tuberculosis are more apt to be multiple and found upon the posterior surface of the larynx. Now, why should they be upon the posterior part? Because during sleep the patient rests upon his back, and the sputum, by gravity, falls to the posterior part of the larynx and

FIG. 64.

Elastic fibres in sputum. (R. V. JAKSCH.)

is not coughed up, as it is in the waking hours; consequently the bacilli act upon these parts. A large class of tumors is found in the region of the vocal cords. Such a tumor may lead to quite serious results by falling down and so obstructing the air-passages. Foreign bodies sometimes reach the larynx and cause like symptoms. A jack-stone, for instance, may be taken into the larynx and cause obstruction. Cancers and sarcomas are found. Cancers usually involve the larynx by extension from the œsophagus. They usually infiltrate the surrounding tissues to a considerable extent, and it is for this reason that extirpation of the larynx is such a difficult feat when performed for a malignant growth.

Bronchi. Inflammatory conditions of the bronchi are frequently set up by micro-organisms or through the irritation of dust, etc.

Abscess and gangrene are usually studied together; they result from septic embolism usually caused from some suppurative area elsewhere in the body, the micro-organisms of which are carried to the lung and set up either gangrene or abscess according to the

cause. A case was shown at a meeting of the Pathological Society in which gangrene of the lungs had followed necrosis of the tibia following amputation. We cannot quite tell why in one case gangrene should result and in another abscess. Abscess may be either acute or chronic, and may rupture either into the bronchial tubes or into the pleura. In the former condition the patient may expectorate large quantities of pus. Not infrequently an abscess of the pleura involves the lung by eating its way in.

The inhalation of dust of various kinds may produce an inflammation of the lung. Workers in stone get a disease known as calcicosis; workers in iron, siderosis or grinder's phthisis. Many of the mineral substances contain silicon, and there is a disease known as silicosis. Anthracosis is quite common among the persons who work in coal dust; it produces the disease known as coal-dust phthisis.

If in your practice you should be consulted by a patient who works in coal dust, and he comes to you with the symptoms of lung disease, you may get valuable help by examining the palms of his hands, noticing whether there are spots of coal pigment. In anthracosis the entire lung is of a black color, and usually shows a considerable increase of connective tissue. Of course, true phthisis is not caused by the inhalation of coal dust; it can only occur when the bacillus gains entrance to the lung, but the irritation produced by the particles of carbon predisposes the lung to the action of the bacillus. True phthisical cavities are formed in such a lung, and in a specimen shown you will notice large cavities in a lung black with carbon. There is always in these forms of phthisis the formation of large amounts of connective tissue, and for this reason the course is chronic.

Hemorrhages of the lung, sometimes called pulmonary apoplexies, are caused by active congestion, which may follow rapid running and exercise; they may prove fatal. Some peculiar cases have occurred in which the pulmonary apoplexy has followed a lesion in the pons or medulla; in such a case the pulmonary hemorrhage may be upon the opposite side to that in which the cerebral injury has occurred.

Atelectasis is of two forms: 1. That known as the fœtal atelectasis, in which the lung-tissue has never expanded. 2. That due to *obstruction* to the passage of air, which causes the collapse of a part of the lung of small or large area.

Bronchitis. There are several varieties of inflammation of the

bronchial tubes, to which a number of names are given, such as acute, chronic, capillary, and so forth. In the capillary form the very small bronchioles are involved, and there is almost always more or less catarrhal pneumonia present.

In **brown induration** the lung is hard from excessive quantity of connective tissue and is dark from pigmentation. There is an interstitial process of new connective-tissue formation going on.

Congestion of the lung may be most marked, and it is often impossible on the post-mortem table to tell it from the lung in the early stages of pneumonia.

Emphysema produces a marked change in the appearance of the lungs; the air-vesicles are distended. It is quite common to find this condition in old people. It may be produced by violent efforts in expiration, as in the cough of whooping-cough. The condition is easily recognized: the lung will be enlarged and light, floating high up when thrown upon water; it has a characteristic feel, crackling when you press upon it, and you can with very little force cause the air to come to the surface, where it appears as a bleb.

Fat Embolus. The lungs are sometimes seen to contain emboli and fat; this may follow fracture of some bone and may occur in diabetes.

Infarctions. The majority are of the **hemorrhagic** variety. They present the peculiar wedge shape with which you are familiar, with the base toward the periphery. Anæmic infarcts sometimes occur.

In **œdema** of the lungs the tissue is infiltrated with serum; this occurs especially in the dependent portions; it comes on very often just before death, and is common in old age and in many of the acute diseases.

Pleurisy is nearly always an accompaniment of pneumonia, and here is acute. The chronic forms of pleurisy are now thought to be due largely to tuberculosis. The sero-fibrinous exudate is the most common upon this membrane, and quite frequently leads to extensive adhesions between the parietal and visceral layers.

Pneumonia. A most important subject. The most important forms are the croupous and catarrhal.

Croupous pneumonia is called lobar pneumonia, and catarrhal pneumonia lobular pneumonia.

In croupous pneumonia there are four well-marked stages: 1. Engorgement. 2. Red hepatization. 3. Gray hepatization, and 4. Resolution.

In the first stage the lung is much engorged with blood, and enlarged on this account. In the stage of red hepatization the lung is really enlarged, is heavy and sinks in water. A cut surface is granular and looks like marble; this is due to the small plugs of fibrin which stand up from the air-vesicles, and are capable of being scraped off with a knife and examined under the

Fig. 65.

Fibrinous casts, from a case of pneumonia. They also occur in bronchial croup. (R. v. Jaksch.)

microscope. In the stage of gray hepatization there is something of a cheesy change, and the affected areas are light from fatty degeneration and from anæmia; the leucocytes are also greatly in excess. You have seen during the year numerous fresh specimens showing the lung in the different stages of red hepatization, and you will be able to recognize the small plugs of fibrinous material in the air-vesicles.

Syphilis of the lung is rather a rare condition. We generally find in this a fibrous change which may or may not be associated with tuberculosis.

Tumors. Many of the benign growths are found here, and also the primary and secondary carcinomata and sarcomata.

TABLE SHOWING DIFFERENCES BETWEEN CROUPOUS AND CATARRHAL PNEUMONIA.

Croupous.	*Catarrhal.*
1. Whole lobe usually affected; hence the name lobar pneumonia. Syn., Fibrinous; pleuro-pneumonia.	1. Lobules affected, hence the name lobular pneumonia. Syn., Broncho-pneumonia.
2. No areas of healthy lung tissue in affected lobes; other lobes healthy, but congested.	2. Irregular areas of lung tissue in various stages of degeneration intermingled with normal lobules.

Croupous.	*Catarrhal.*
3. Lung weighs much more than normal. An entire lobe may sink in water.	3. Lung weighs but slightly more than normal. An entire lobe will float on water, though small portions may sink.
4. Microscope. Varies according to stage.	4. Microscope. Three zones: centre, a small bronchus; middle, a desquamative area containing many cells, little or no fibrin; outer, zone of congestion.
5. An extensive fibrinous exudate on the pleura covering the affected area.	5. Exudate slight, if present.
6. Pneumococcus found in nearly all cases.	6. Pneumococcus rarely found.
7. Usually at base and posteriorly.	7. Usually at the termination of the smaller bronchioles and anywhere in the lung.
8. Usually one-sided.	8. Usually on both sides, and associated with other diseases.
9. On section the lung varies according to stage, the marbled appearance being especially striking in the third stage. Notice the fibrinous plugs.	9. On section the lung is congested. Small angular irregular patches, the central portion being the oldest, are seen.
10. Sputum, so-called rusty sputum.	10. Sputum more purulent.
11. Lung of same age.	11. Diseased portion of lung varies; some spots old, some new, the oldest being around the bronchioles; healthy tissue between affected areas. Caseous pneumonia, really a form of catarrhal pneumonia, is due to the action of a toxine, as from the tubercle bacilli. In phthisis there may be small areas of croupous pneumonia.
	12. Capillary bronchitis and catarrhal pneumonia are, pathologically, practically the same.

Alimentary Tract.

Exhibits.

1. Typhoid ulcers.
2. Tubercular ulcers.
3. Tubercular peritonitis.

4. Dysenteric ulcers due to the amœba coli.
5. Lipoma of the large intestine.
6. Appendicitis due to a pin.
7. Tubercular appendicitis.
8. Streptococci appendicitis.
9. Gastric ulcer.
10. Stomach from a case of arsenical poisoning.
11. Stomach from a case of carbolic acid poisoning.
12. Scirrhus cancer of the pyloric end of the stomach.
13. Secondary cancer of the liver.
14. Fatty liver.
15. Acute yellow atrophy.
16. Abscess of the liver.
17. Gall-stones.
18. Cirrhosis of the liver.
19. Amyloid liver.
20. Echinococcus cyst of the liver.
21. Leukæmic liver.

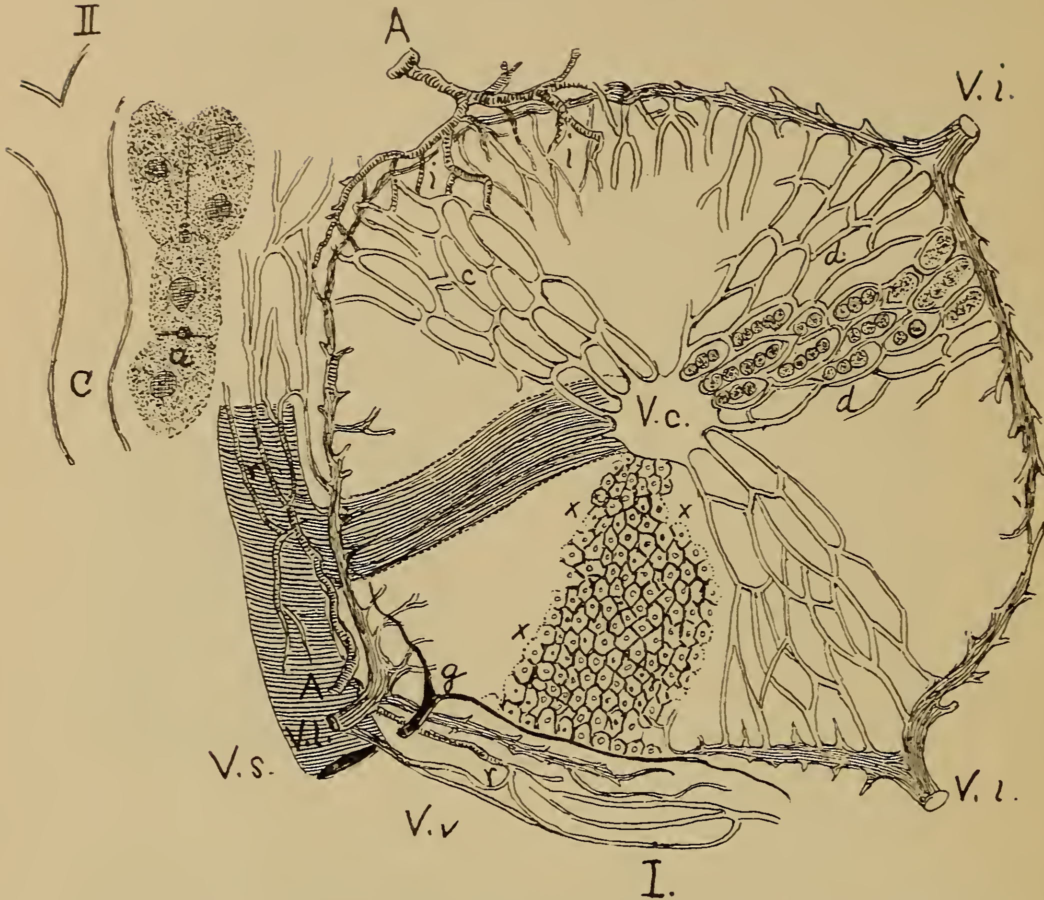
Typhoid Ulcer.	*Tubercular Ulcer.*
1. Direction often longitudinal.	1. Direction transverse (frequently). This distinction is not so characteristic as is sometimes held.
2. Edges undermined, ragged, and can be floated out on water; thin, vascular, and composed of mucosa and submucosa—red.	2. Edges not undermined; thick, prominent, nodulated, terraced, or sloping—pale or red, composed of tissue infiltrated with tubercular nodules.
3. Floor smooth and vascular.	3. Floor nodular, irregular, thickened, irregular, vascular, with pale or yellow points or areas.
4. Peritoneal surface unaltered, except that it may be inflamed. No thickening and no gray or yellow patches.	4. Peritoneum thickened—small yellow or gray points in the floor of ulcer running along the lines of the lymphatics.
5. Mesentery unaltered; glands enlarged, vascular, pink, and softened.	5. Mesentery thickened at its attachment to the bowel; glands enlarged, firm and gelatinous on section, or caseous.

Typhoid Ulcer.	*Tubercular Ulcer.*
6. Perforation more common both by separation of slough and by direct extension of the ulcerative process. Small opening by which the feces may escape. Peritonitis. Hemorrhage may occur during either of these processes.	6. Perforation, peritonitis, and hemorrhage—all rare.
7. Microscopically: A specific inflammation affecting the adenoid tissue; bloodvessels distended, and increased vascularity of the mucosa and submucosa. Dense masses of small round cells—lymphoid cells and leucocytes—with some large multinucleated cells, the latter of which are derived directly from endothelioid cells. A line of demarcation is formed, and abscess results, beginning in the solitary glands and other lymphoid tissue of the mucosa and submucosa.	7. Microscopically: A specific inflammatory affection also of the adenoid tissue and the mucous membrane, ending in caseation and connective-tissue formation; vascularity of mucosa and submucosa; increase of connective-tissue cells and lymphoid cells; tubular nodules, typical or caseating. It begins in the mucous membrane, and, like the typhoid lesion, is due to direct contagion or infection.
8. Extension takes place laterally or in depth.	8. Extension usually takes place laterally.
9. Heals by granulation, the thin edges falling on to and uniting with the granulating floor of the ulcer.	9. Very rarely heals.
10. Leaves a smooth, often depressed, pale, anæmic, or pigmented cicatrix, covered by a layer of epithelium, but no gland tissue. Seldom breaks out afresh, relapses being due to the affection of adenoid patches previously little damaged.	10. Leaves a puckered cicatrix in which are gray or white nodules; often breaks out afresh.

[WOODHEAD'S *Practical Pathology*, 3d edition, p. 455.]

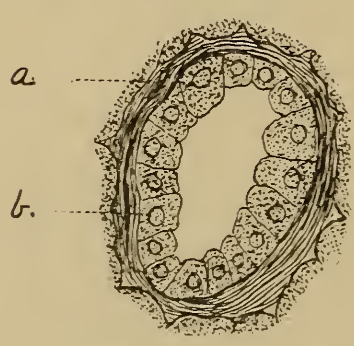
The finding of the typhoid bacillus, by culture and staining methods, and of the tubercle bacillus by culture, inoculation, and staining methods are the most important for diagnostic purposes.

FIG. 66.



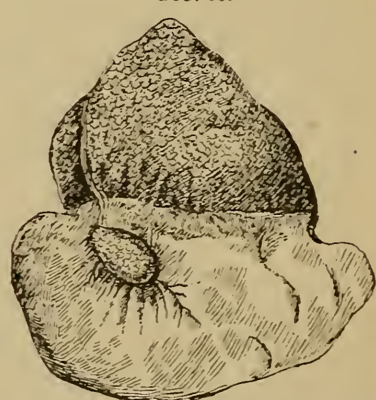
I. Scheme of a liver-lobule. V. i, V. i, inter-lobular vein (portal); V. c, central or intra-lobular vein (hepatic); c. c, capillaries between both; V. s, sub-lobular vein; V. v, vena vascularis; A, A, hepatic artery, giving branches, r, r, to Glisson's capsule and the larger vessels, and ultimately forming the venæ vasculares at i, i, opening into the intra-lobular capillaries; g, bile-ducts; x, x, intra-lobular biliary channels between the liver cells; d, d, position of the liver cells between the meshes of the blood-capillaries. II. Isolated liver cells; c, a blood-capillary; *a*, fine bile-capillary channel. (LANDOIS and STIRLING.)

FIG. 67.



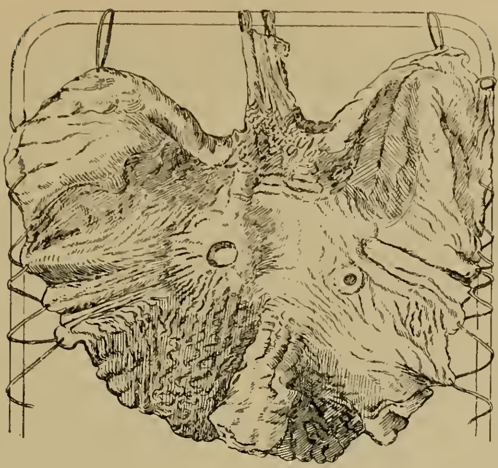
Human inter-lobular bile-duct. (LANDOIS and STIRLING.) *a*. Circular fibres. *b*. Cylindrical epithelium.

FIG. 68.



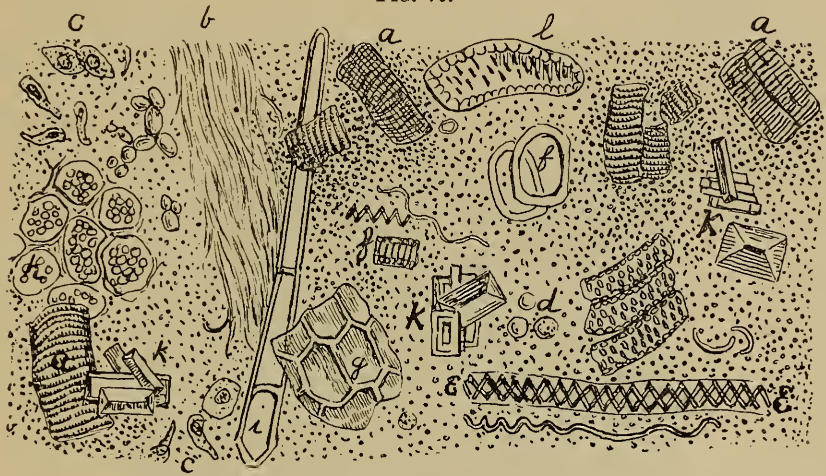
A small extra lobe of the liver lying upon the gall-bladder, and connected with the right lobe by means of vessels and duct.

FIG. 69.



Gastric ulcer in which perforation has occurred. The most common seat is posteriorly, near the pyloric end and lesser curvature of the stomach. (Specimen in the Museum of Morbid Anatomy.)

FIG. 70.



Common objects found under the microscope in the examination of the feces. (R. v. JAKSCH.)

a. Muscle fibres. *b.* Connective tissue. *c.* Epithelium. *d.* White blood-cells. *e. f. g. h. i. l.* Various forms of plant cells. *k.* Triple phosphate crystals. The black dots represent various forms of micro-organisms.

FIG. 71.

Contents of the mouth. (R. v. JAKSCH.)

a. Squamous epithelium. *b.* Salivary corpuscles. *c.* Fat-drops. *e.* Spirochæta buccalis. *f.* Comma bacillus of the mouth. *g.* Leptothrix buccalis. *h. i. k.* Various forms of fungi.

Parasites.

Fig. 72. Fig. 73.

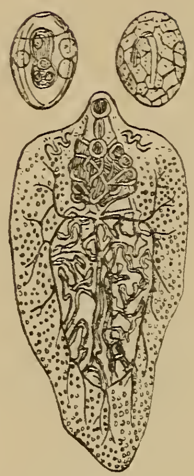
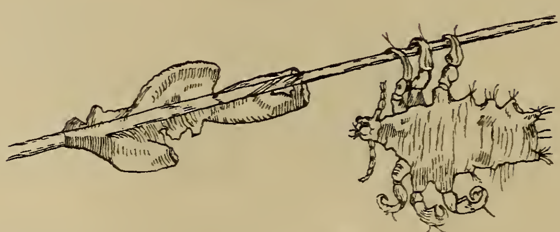


Fig. 74.

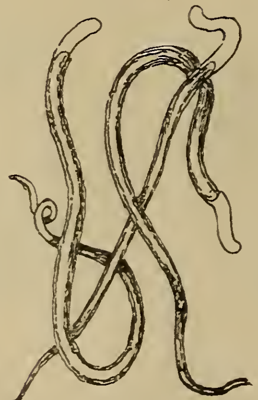
Fig. 72.—Distoma hepaticum. (R. v. Jaksch.)
Fig. 73.—Ascaris lumbricoides. (The larger one.) Female, one-third natural size; head magnified. Male, one-third natural size. (Ziegler.)
Fig. 74.—Gastrophilus equi. (Ziegler.)

Fig. 75.

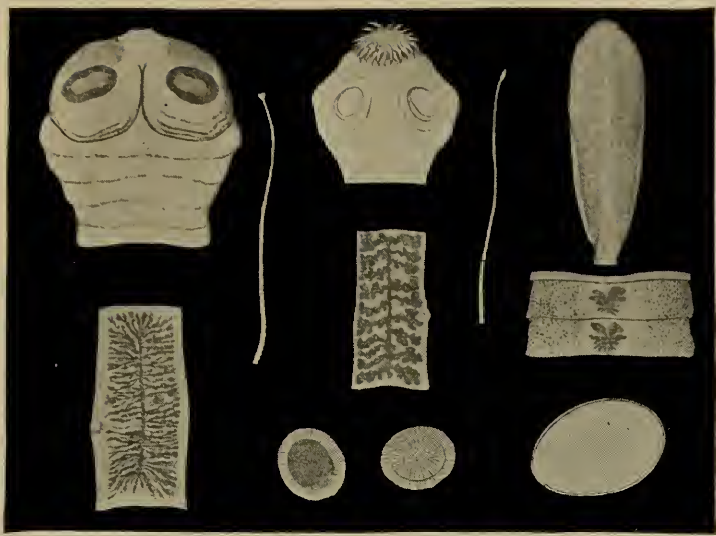


Pediculus pubis, or crab-louse, with ova adhering to the hair.
(Finlayson; drawn by Wilson.)

Fig. 76.

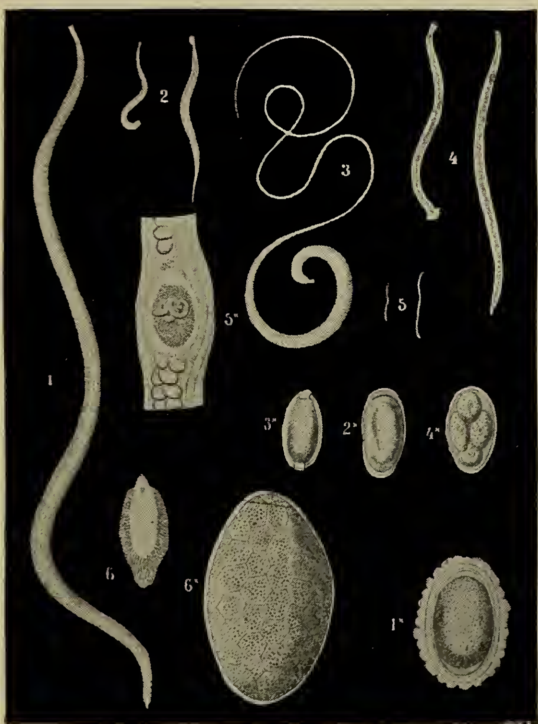


Filaria sanguinis hominis. (R. v. Jaksch.)



Tænia saginata (mediocanellata). T. solium. Bothriocephalus latus.

Head, × 10. Segments, natural size. Eggs, × 200. The head and first segments of the tænia saginata and of the tænia solium are reduced one-half.



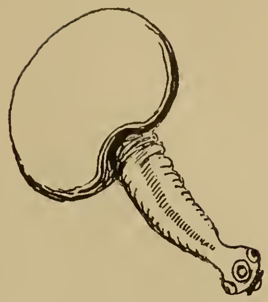
1. Ascaris lumbricoides (one-half natural size). 1*. Egg, × 180.
2. Oxyuris vermicularis, × 2½. 2*. Egg, × 180.
3. Trichocephalus dispar, ×2½. 3*. Egg, × 180.
4. Anchylostoma duodenale, × 2½. 4*. Egg, × 180.
5. Trichina spiralis, ×2½. 5*. Encysted trichina spiralis, × 30.
6. Distomum hepaticum, ×2½. 6*. Egg, × 180

(From *Atlas der Mikroskopie am Krankenbette*, by Dr. A. Peyer.)

FIG. 77.

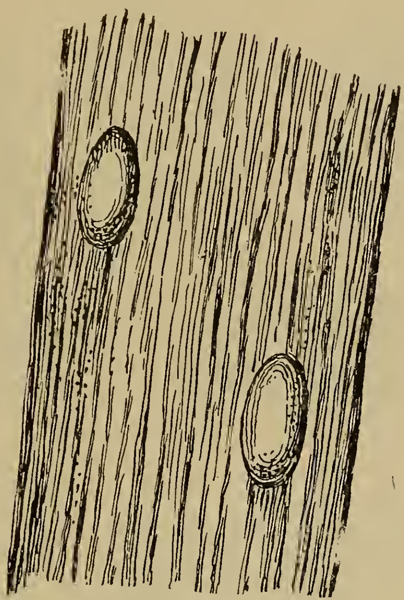
Cysticercus from tænia solium removed from its capsule. (Natural size.) It is surrounded by an embryo sac. Head of hooklets can be seen. (LANDOIS and STIRLING.)

FIG. 78.



Cysticercus of tænia solium with its head and segments protruded. The caudal sac is seen. (LANDOIS and STIRLING.)

FIG. 79.



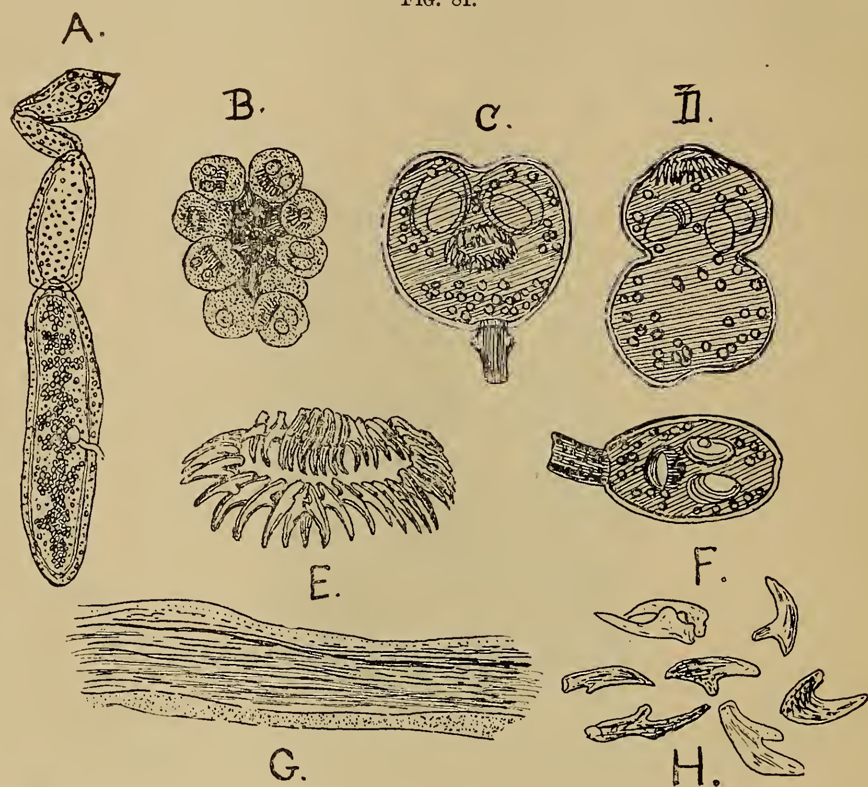
Encapsulated cysticercus from tænia solium, imbedded in a human sartorius. Natural size. (LANDOIS and STIRLING.)

FIG. 80.

a, Trichomonas intestinalis. *b*, Cercomonas intestinalis (BAVAINE). *c*, Amœba coli. *d*, Paramœcium coli. *e*, Monadines, living. *f*, Monadines, dead. (R. V. JAKSCH.)

The tænia echinococcus reaches its mature state in the alimentary tract of the dog; the place where we find the larvæ is both in man and in the lower animals, such as the hog, ox, sheep, rat. Therefore, the true worm does not grow in man; merely the egg is hatched and the worm produced. These changes may be compared to those of the butterfly. The egg is laid by the butterfly (tænia echinococcus), and is hatched into a worm (hydatid worm); the worm forms the cocoon (cyst) and is turned finally again into a butterfly (tænia echinococcus).

FIG. 81.



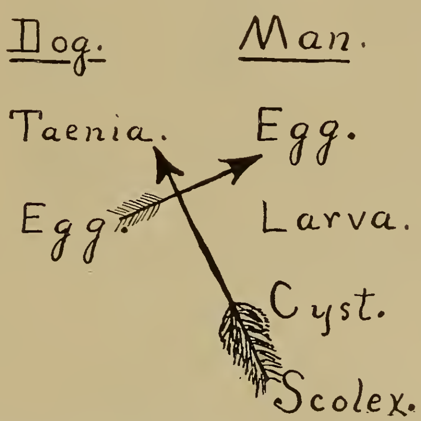
A. Mature tænia echinococcus.
B. Group of echinococci still adhering to the germinal membrane by their pedicles. × 40.
C. Invagination of the head into the caudal vesicle. × 107.
D. Head is here protruded from the caudal vesicle.
E. Rostellum, showing hooklets. × 350.
F. Compressed form.
G. Membrane of cyst-wall.
H. Hooklets from Prof. Goodell's case. × 450.

(A, from COBBOLD; B, C, D, E, from BAVAINE, in FINLAYSON; G, from PEYER.)

The tænia echinococcus is a very small worm—only four to five millimetres in length. It has a head in which there are four openings surrounded by a rostellum, with a double row of hooklets. To this are attached three or four segments. The last segment is the one in which we find the eggs, which may number as many as

five thousand. It is as long as two millimetres and seven-tenth millimetres broad. The dog passes out one of these segments containing the eggs, and the eggs are thus brought in some way in contact with the man or animal, and thus follows the entrance of these eggs into the body; the outside portion of the egg is digested, and we have the echinococcus, with its six hooklets, in the alimentary canal. From this we may have a perforation of the alimentary tract, as the worm possesses amœboid movement, and echinococci may be carried in the venous circulation, even passing the capillaries of the lungs, and thus entering the arterial circulation. Therefore we have the echinococcus; not a tænia, for that occurs in the dog. It gets into the liver, as it has done in the specimen which is shown you, and makes there a cyst, which is known as an echinococcus cyst. This cyst, lined with a membrane, is filled with a clear fluid which does not contain albumin, but which

FIG. 82.



Scheme showing the life history of the tænia echinococcus.

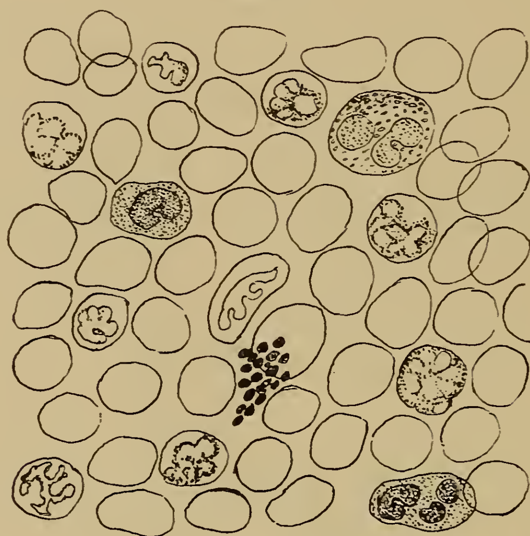
may contain sugar, and later on we have what has been shown you—a proliferation of this embryo and an attempt at the formation of the tænia. If you could imagine the scolex with the segment attached it would resemble that which occurs in the dog. This cyst is lined with thousands and thousands of these little scolices. Soon there is produced from the parenchymatous layer a budding which is usually internal, but which may be external, and then we have what is called the daughter cyst, and we may have a granddaughter cyst, etc., produced in the same manner. So, you see, one of these eggs is capable of producing a cyst, and this cyst is capable of producing hundreds of others lined with millions of scolices, each one of which, if it gets into a dog, is capable of becoming a full-

grown cestode. You see this is very different from the other tape-worm, as, in the tænia solium, for example, one egg, one tape-worm. (See Figs. 81 and 82.)

According to Cobbold, one-sixth of the annual mortality rate in Iceland is due to some form or other of the echinococcus.

Blood.

FIG. 83.



Blood from a case of tertian fever; showing plasmodium, leucocytes, eosinophile leucocytes, and blood plates. Stained by Aldehoff's method. (R. v. JAKSCH.)

FIG. 84.

Rare forms of the plasmodium. (R. v. JAKSCH.)

FIG. 85.

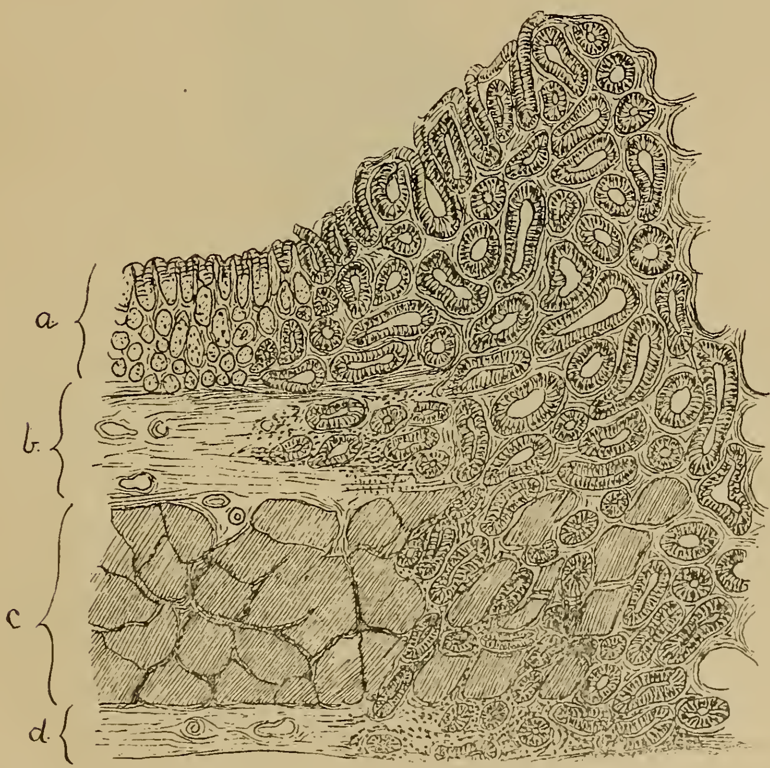
Blood, showing the plasmodium a few hours after an attack of tertian fever. (R. v. JAKSCH.)

Miscellaneous.

FIG. 86.

Transverse section of a normal Fallopian tube (oviduct). The inside portion is made up of connective tissue lined by a single layer of ciliated epithelium. The circular muscular fibres are seen on the outside, the darker portions being spots where these involuntary muscles have been cut across transversely. (LANDOIS and STIRLING.)

FIG. 87.



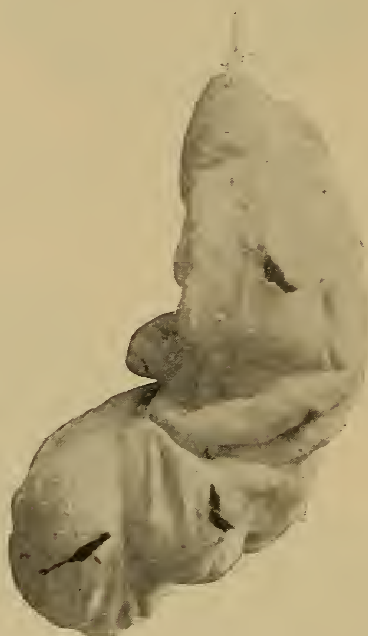
Section through the advancing margin of a destructive adenoma of the stomach. (ZIEGLER.)

a. Mucosa. *b.* Submucosa. *c.* Muscularis. *d.* Serosa. The neoplasm seen on the right of the drawing has started from the mucosa and has then invaded the neighboring tissue. A round-cell infiltration can be seen in places.

Fig. 88.

Smallpox eruption. Portion of the skin of the forearm of a colored person, showing umbilicated pustules hardened in 95 per cent. alcohol. Natural size. (Drawn by Dr. G. K. Edwards. Post-mortem by the author.)

Fig. 89.



Case of hydronephrosis due to a calculus. The kidney is 8½ inches long, 5 inches wide and 4 inches thick. (Stone's case in the Army Medical Museum.)